



(12) **United States Patent**
Kashyap et al.

(10) **Patent No.:** **US 9,361,541 B2**
(45) **Date of Patent:** **Jun. 7, 2016**

(54) **DEVICE PAIRING IN A NETWORK**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 132 days.

(21) Appl. No.: **14/102,612**

(22) Filed: **Dec. 11, 2013**

(65) **Prior Publication Data**

US 2015/0161477 A1 Jun. 11, 2015

(51) **Int. Cl.**
G06K 9/00 (2006.01)
G06K 9/62 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **G06K 9/6212** (2013.01); **G06K 9/00288** (2013.01); **H04H 60/56** (2013.01); **H04N 21/25816** (2013.01); **H04N 21/2668** (2013.01); **H04N 21/4122** (2013.01); **H04N 21/4126** (2013.01); **H04N 21/41407** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC G06F 1/1643; G06F 3/147; G06F 17/00; G01C 21/343; G01C 21/362; G01C 21/3647; G01C 22/002; G09G 2360/02; H04N 5/23293; H04N 21/4223; H04N 5/2258; H04N 1/00307; H04N 1/00408; H04N 7/185; H04N 5/23216;

H04N 5/772; H04N 5/23219; H04N 21/441; H04N 21/4753; H04W 92/18; H04W 48/04; H04W 4/04; H04M 1/26; H04M 1/727; A63B 2220/806; A63B 2220/807; A63B 2220/14; A63B 2225/15; H02J 7/022; G02B 6/122; A61B 2562/146; H01L 31/054; G07F 17/3211

USPC 382/116–118, 181, 284; 348/181–182, 348/135, 158, 208, 222, 286–292
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,474,315 B1 * 1/2009 Hendry G09G 5/003 345/549
7,650,445 B2 * 1/2010 Ma G06F 3/0231 382/181

(Continued)

OTHER PUBLICATIONS

McCune, J.M., “Seeing-Is-Believing: Using Camera Phones for Human-Verifiable Authentication”, A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree Master of Science, May 2005, pp. 1-46, Electrical and Computer Engineering, Carnegie Mellon University, Pennsylvania, United States.

(Continued)

Primary Examiner — Vu Le

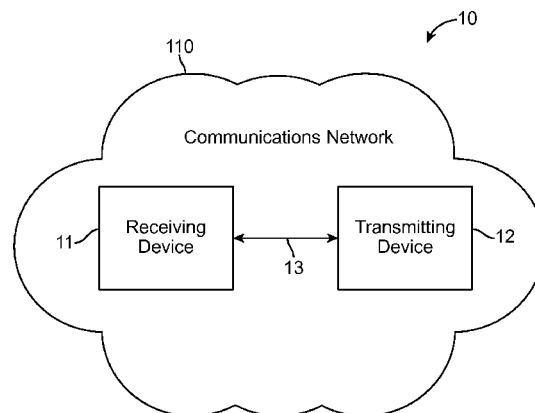
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(57) **ABSTRACT**

A method for device pairing including displaying at least one image having a first characteristic using a first application by a first electronic device. It is determined if the image is recognizable. If the image is determined to be recognizable, pairing the first electronic device with a second electronic device.

30 Claims, 19 Drawing Sheets



- (51) **Int. Cl.**
- | | | | | | |
|------------------------------|--|-------------------|-----------------|---------------------|---|
| <i>H04H 60/56</i> | (2008.01) | 2008/0106621 A1 * | 5/2008 | Jung | H04N 1/00132 |
| <i>H04N 21/258</i> | (2011.01) | 2008/0219589 A1 * | 9/2008 | Jung | 348/262 |
| <i>H04N 21/2668</i> | (2011.01) | 2009/0002379 A1 * | 1/2009 | Baeza | H04N 1/00068 |
| <i>H04N 21/41</i> | (2011.01) | | | | 382/276 |
| <i>H04N 21/4223</i> | (2011.01) | 2010/0198453 A1 * | 8/2010 | Dorogusker | G06T 1/20 |
| <i>H04N 21/436</i> | (2011.01) | | | | 345/522 |
| <i>H04N 21/4363</i> | (2011.01) | 2010/0303437 A1 | 12/2010 | Leichsenring et al. | A63B 24/0062 |
| <i>H04N 21/441</i> | (2011.01) | 2011/0159814 A1 | 6/2011 | Mallinson et al. | 701/31.4 |
| <i>H04N 21/442</i> | (2011.01) | 2012/0159340 A1 * | 6/2012 | Bae | G06F 3/0488 |
| <i>H04N 21/414</i> | (2011.01) | | | | 715/738 |
| <i>H04N 21/44</i> | (2011.01) | 2012/0200419 A1 * | 8/2012 | Nylund | H04L 67/18 |
| | | | | | 340/686.1 |
| | | 2012/0242852 A1 * | 9/2012 | Hayward | H04N 5/23212 |
| | | | | | 348/222.1 |
| (52) U.S. Cl. | | 2012/0278764 A1 * | 11/2012 | Arriola | G06F 17/30058 |
| CPC | <i>H04N21/4223</i> (2013.01); <i>H04N 21/43615</i> | | | | 715/835 |
| | (2013.01); <i>H04N 21/43637</i> (2013.01); <i>H04N</i> | 2013/0144464 A1 * | 6/2013 | Dorogusker | A63B 24/0062 |
| | <i>21/441</i> (2013.01); <i>H04N 21/44008</i> (2013.01); | | | | 701/1 |
| | <i>H04N 21/44218</i> (2013.01); <i>G06K 9/00</i> | 2013/0222627 A1 * | 8/2013 | Earnshaw | G04N 5/23203 |
| | (2013.01); <i>G06K 9/00221</i> (2013.01); <i>G06K</i> | | | | 348/211.2 |
| | <i>2009/6213</i> (2013.01) | 2013/0329114 A1 * | 12/2013 | Kim | H04N 5/2628 |
| | | | | | 348/333.12 |
| | | 2014/0013100 A1 | 1/2014 | Menzel et al. | |
| | | 2014/0013236 A1 * | 1/2014 | Horsman | G06F 9/4443 |
| | | | | | 715/744 |
| (56) References Cited | | 2014/0282718 A1 | 9/2014 | Jacoby | |
| | | 2015/0046559 A1 | 2/2015 | Shariff et al. | |
| | | | | | OTHER PUBLICATIONS |
| | U.S. PATENT DOCUMENTS | | | | U.S. Non-Final Office Action for Application U.S. Appl. No. |
| | 8,610,836 B2 * | 12/2013 | Chuang | H04N 5/44591 | 14/225,353 mailed Aug. 12, 2015. |
| | | | | 345/169 | |
| | 8,630,586 B2 | 1/2014 | Dvortsov et al. | | |
| | 9,083,658 B2 | 7/2015 | Hawver et al. | | |
| | 2006/0174206 A1 * | 8/2006 | Jung | H04N 1/00132 | |
| | | | | 715/751 | |
- * cited by examiner

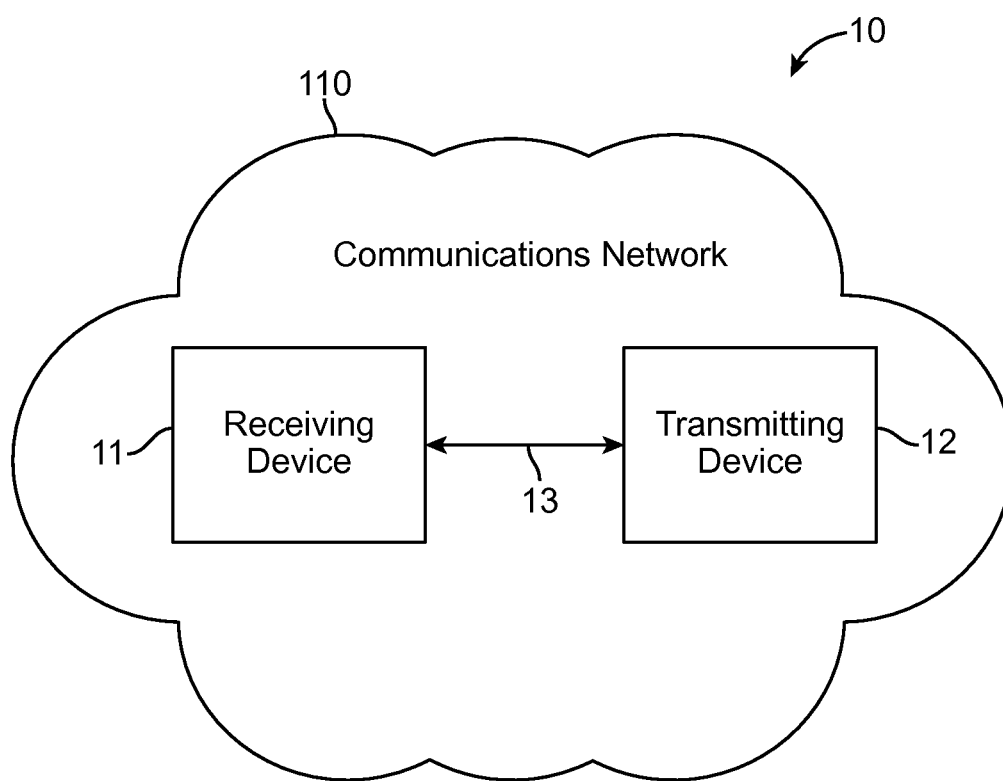


FIG. 1

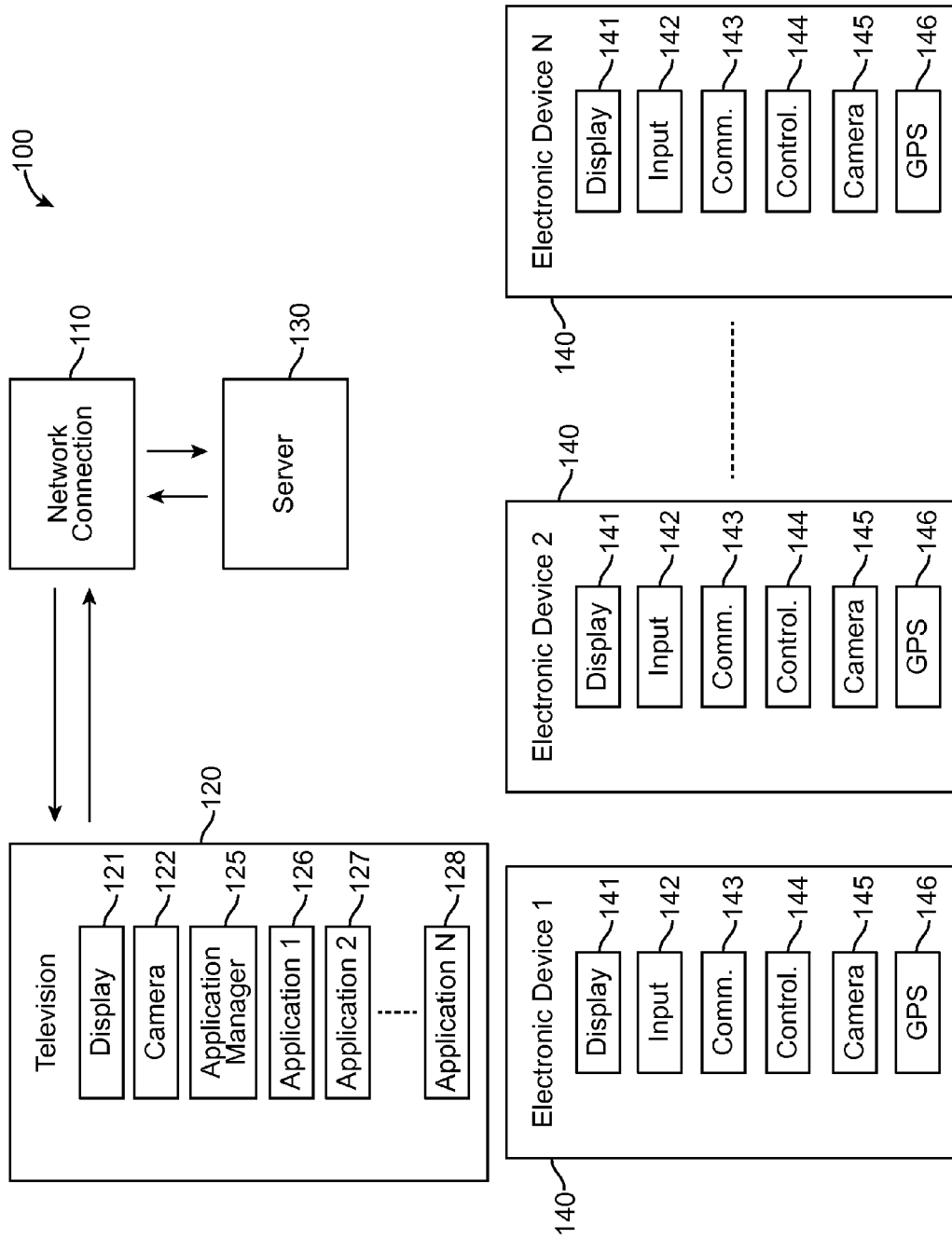


FIG. 2

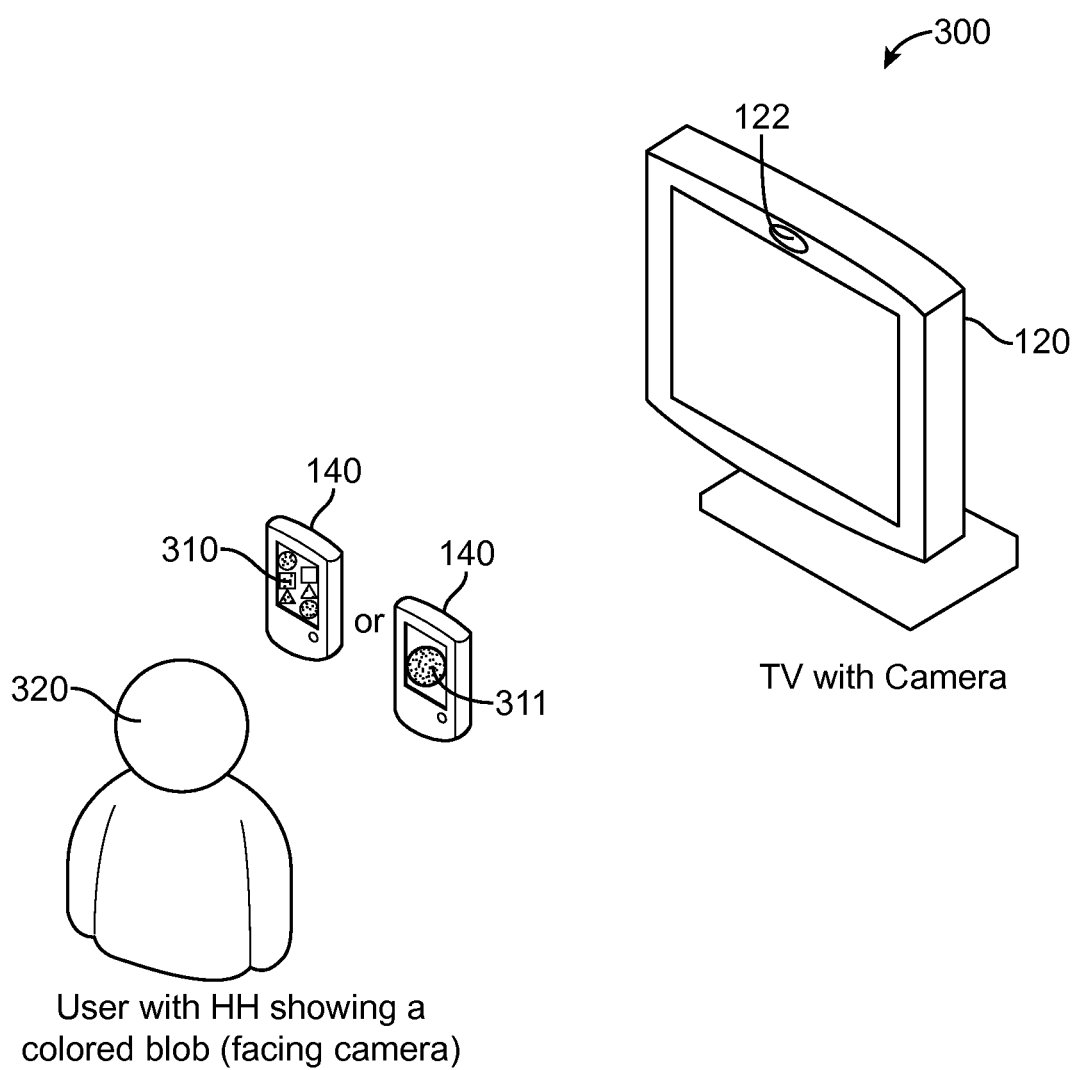


FIG. 3

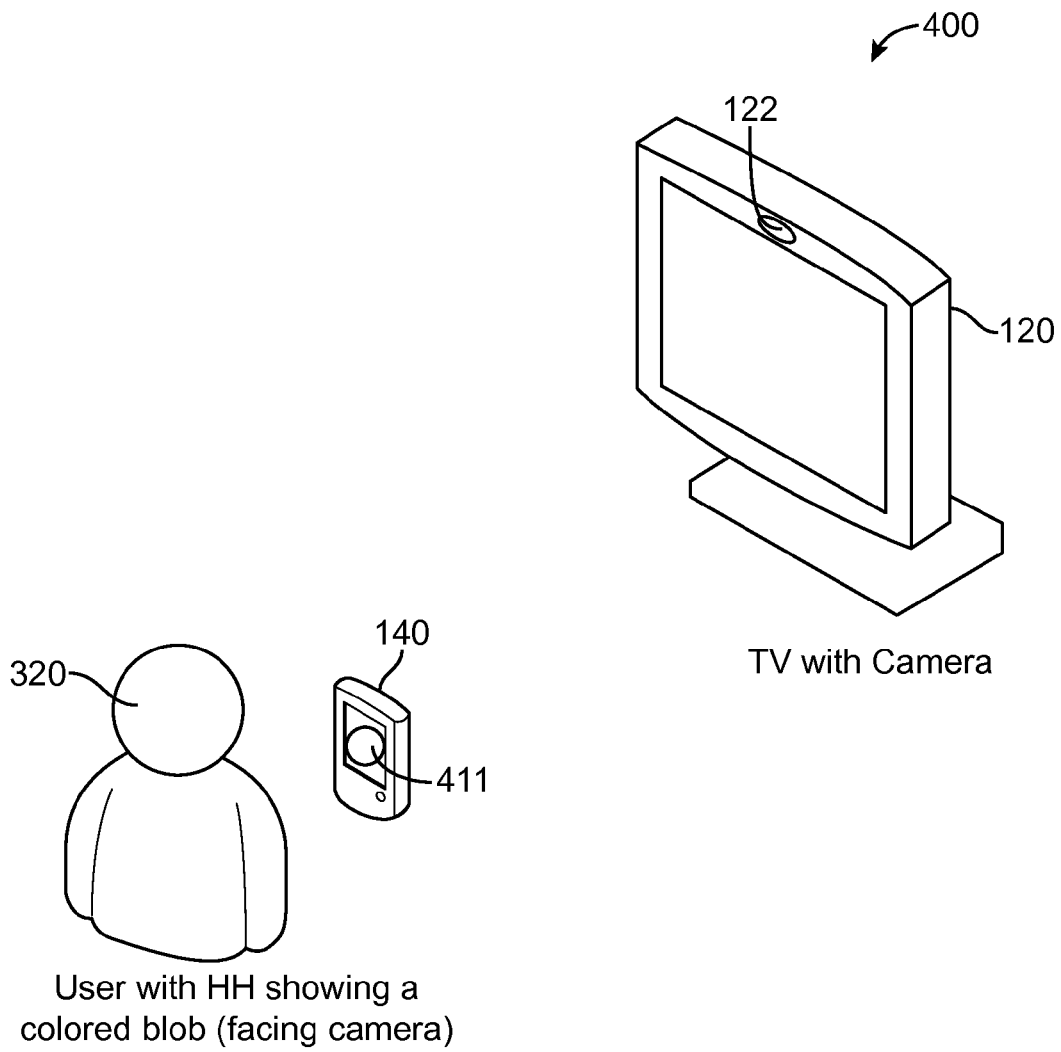


FIG. 4

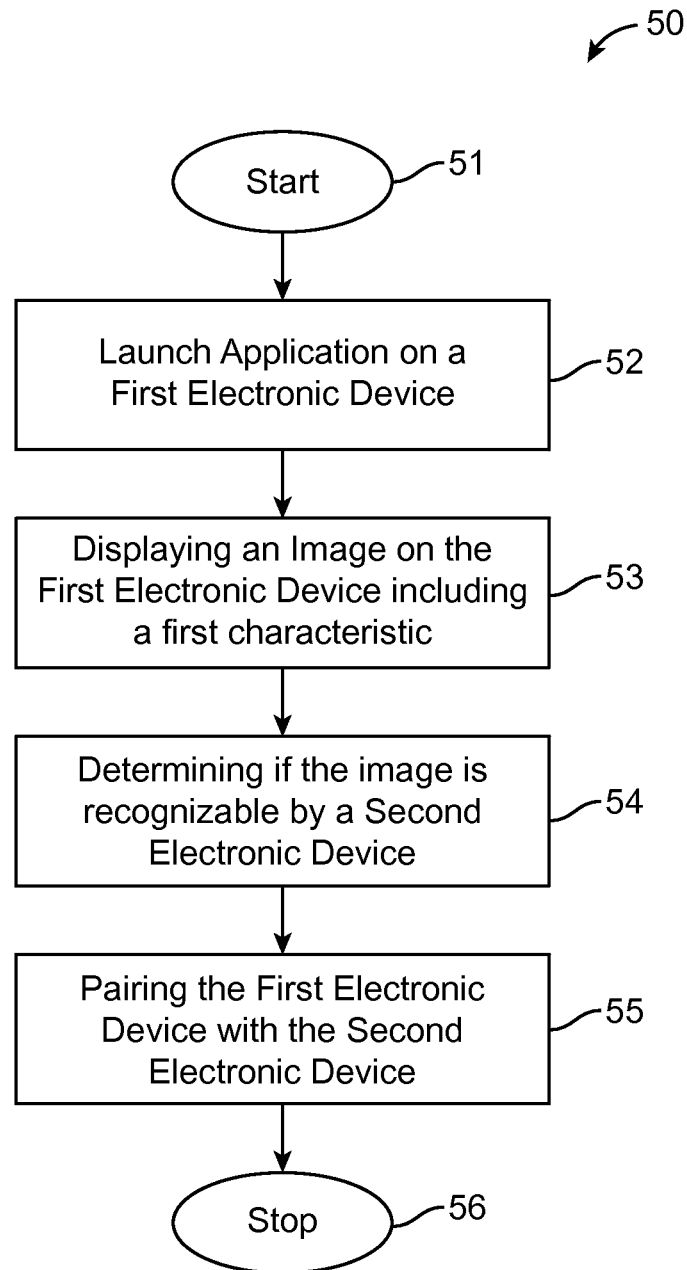


FIG. 5

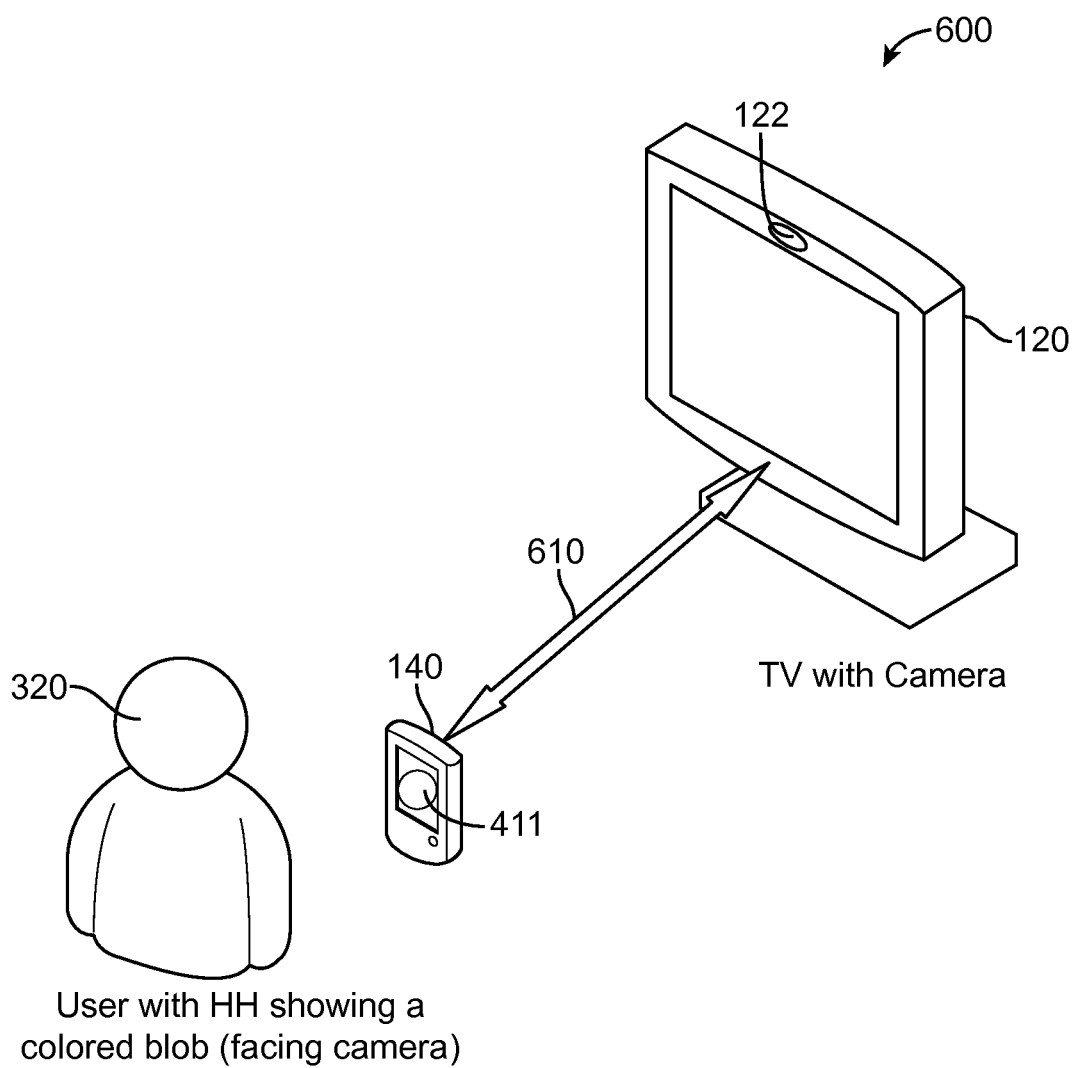


FIG. 6

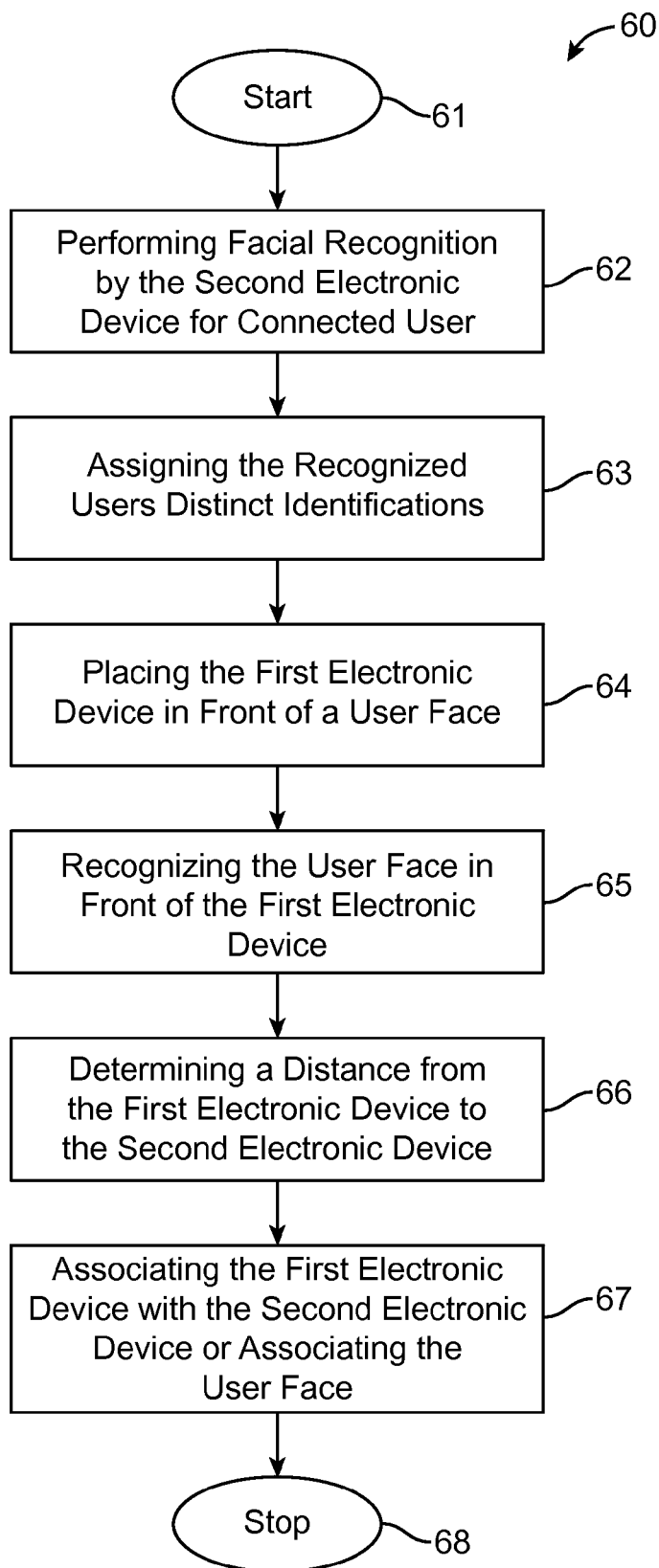


FIG. 7

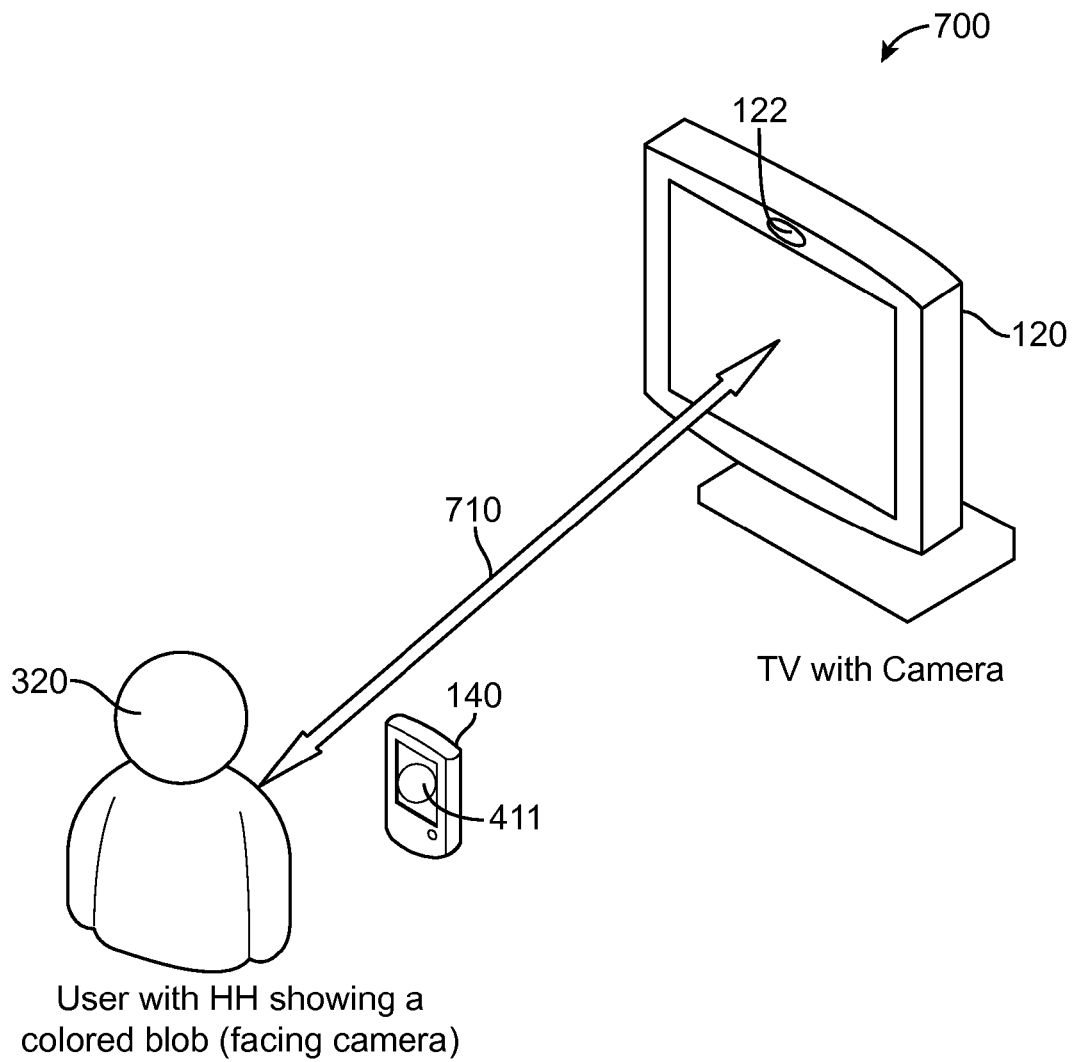


FIG. 8

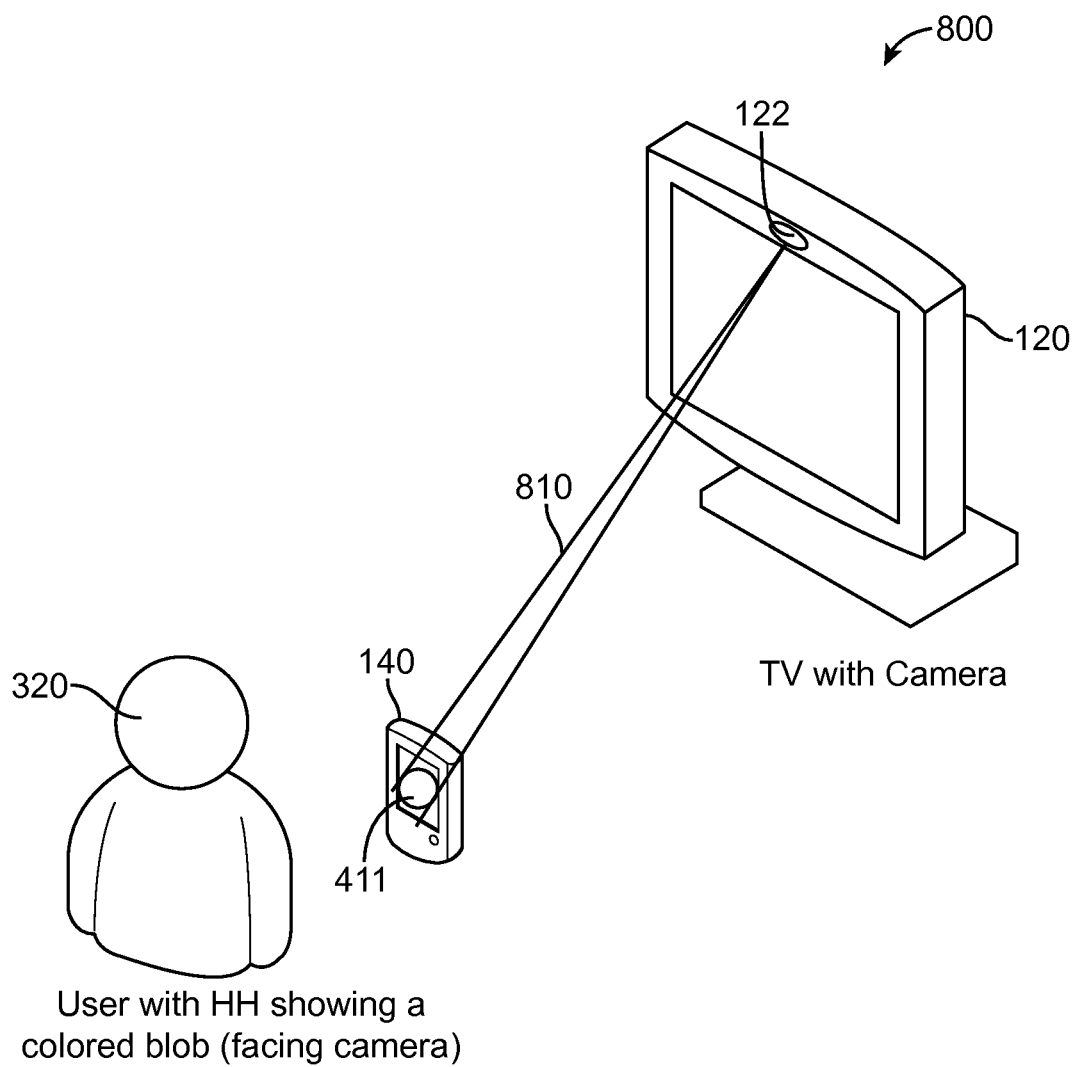


FIG. 9

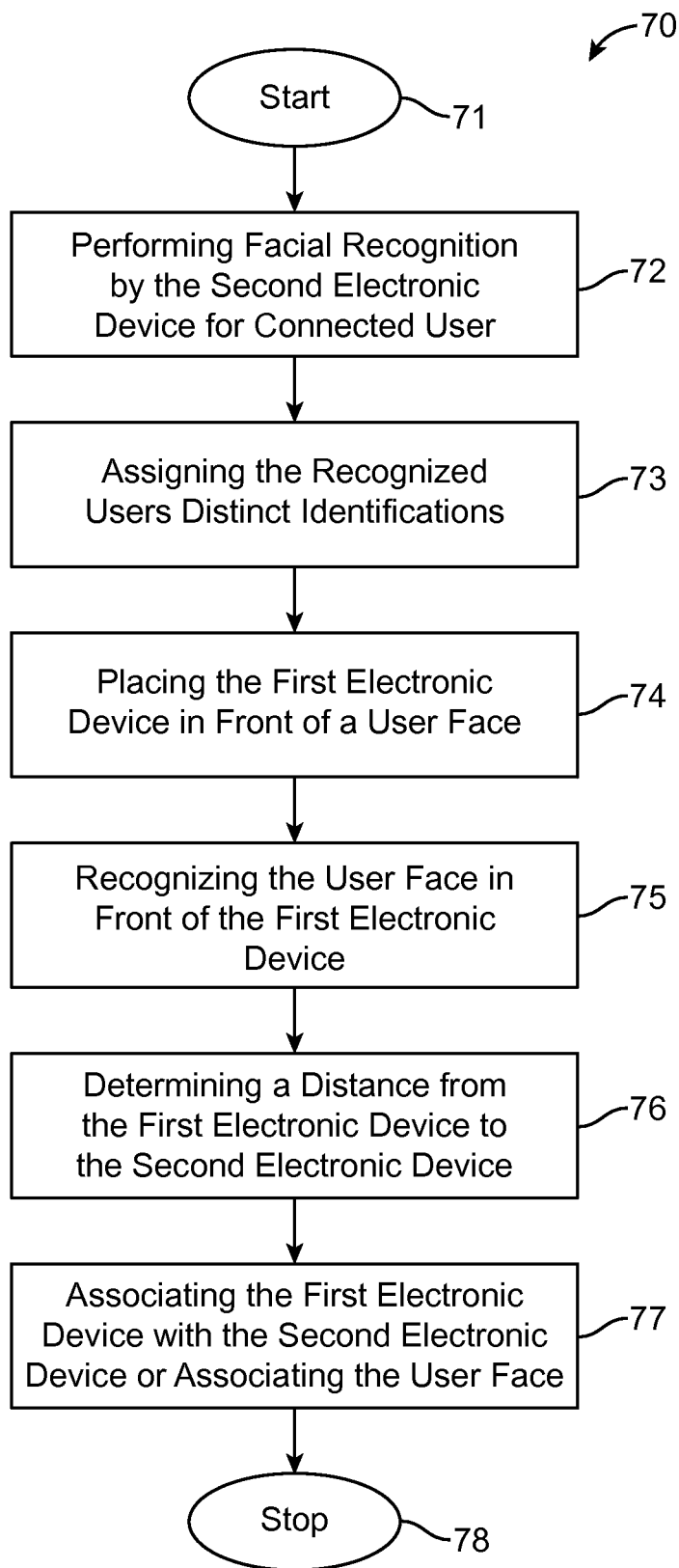


FIG. 10

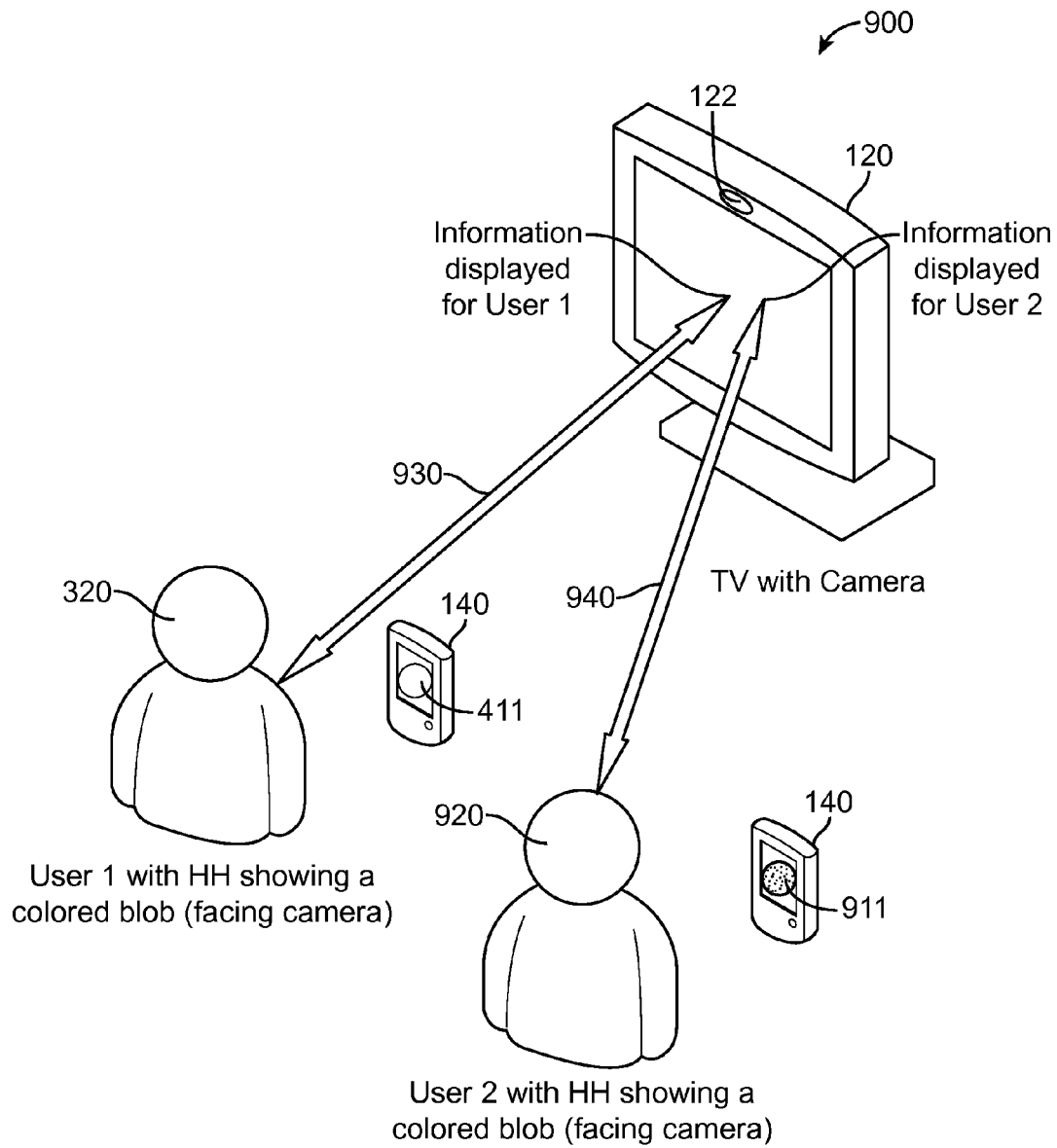


FIG. 11

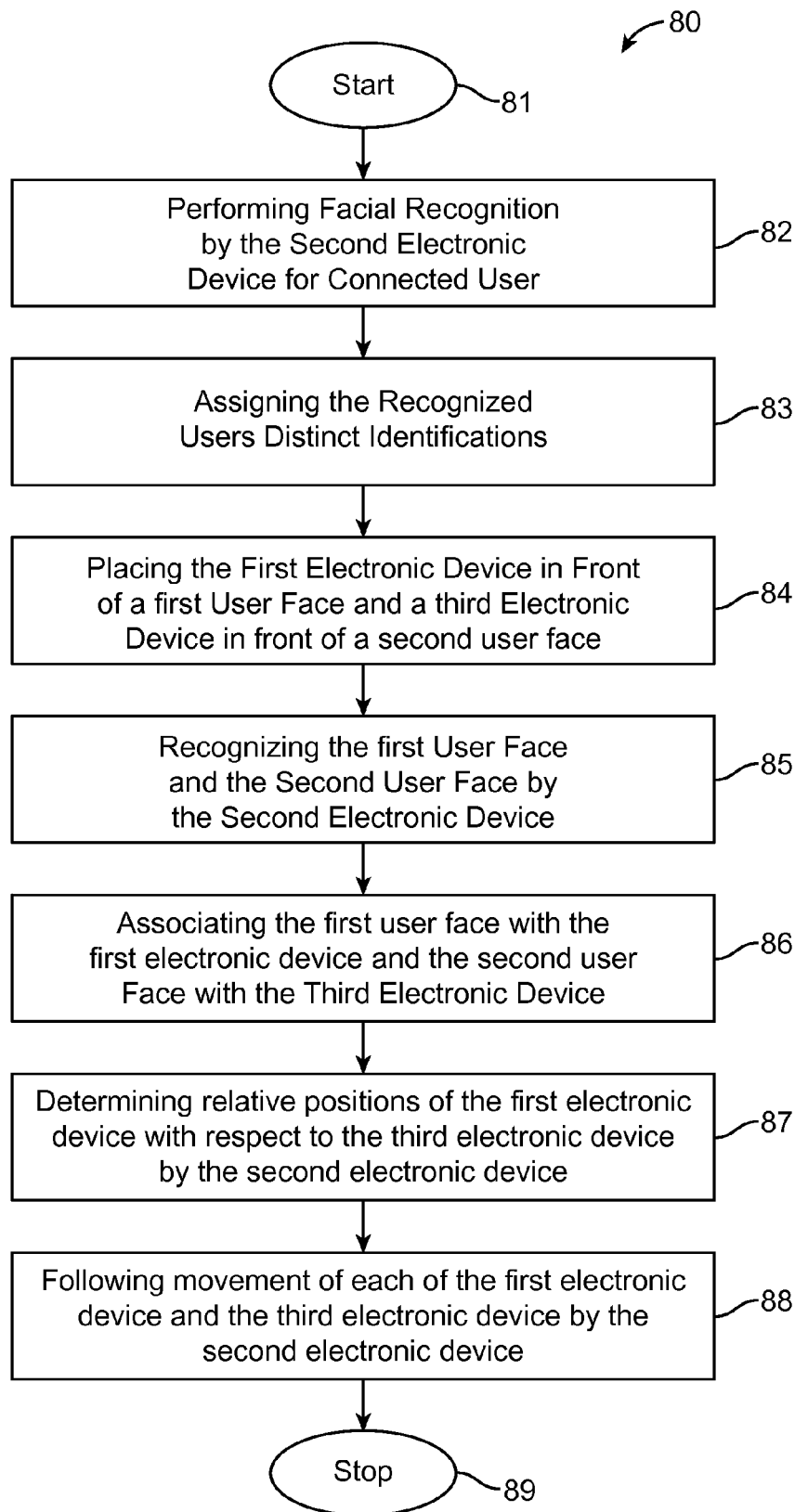


FIG. 12

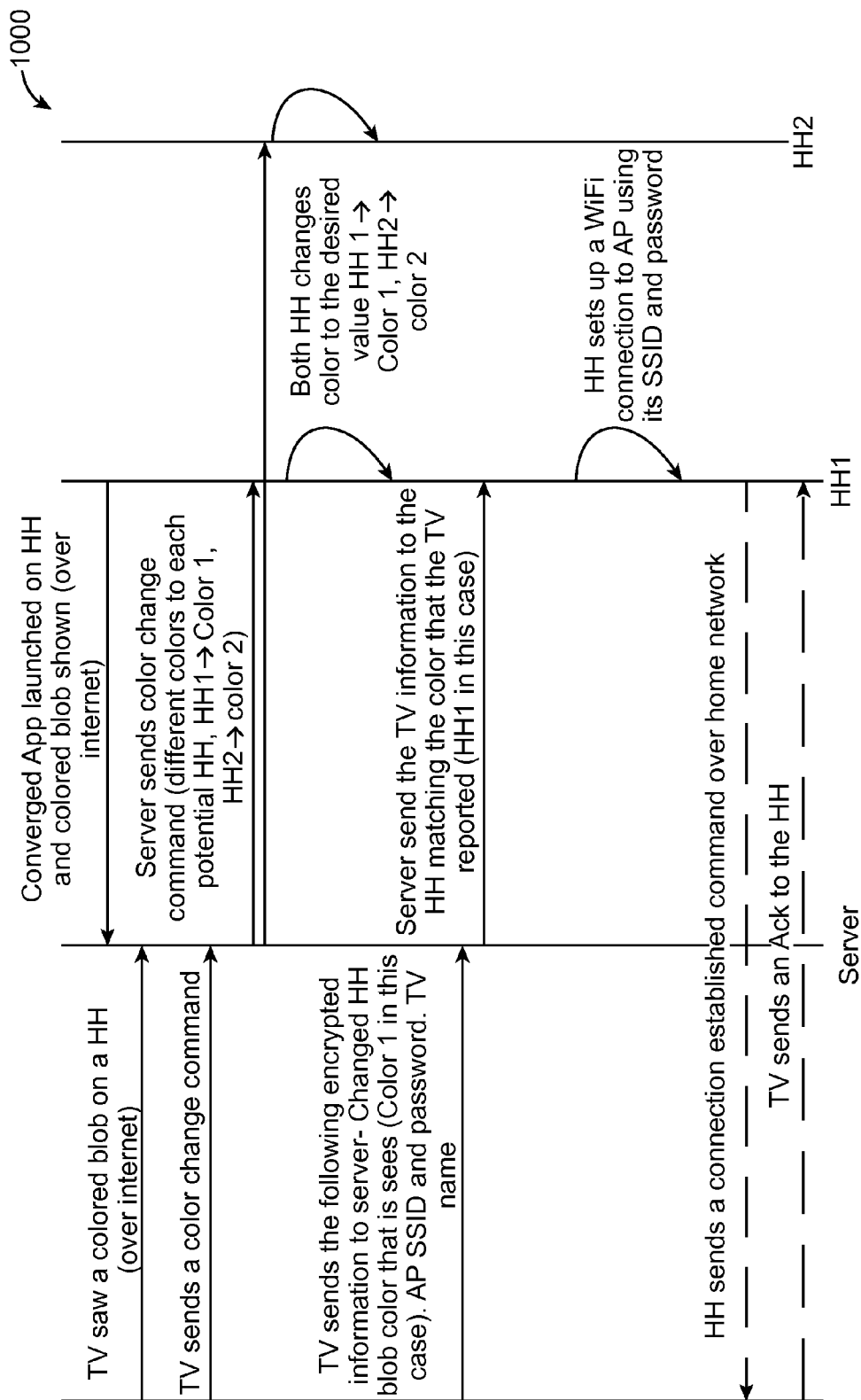


FIG. 13

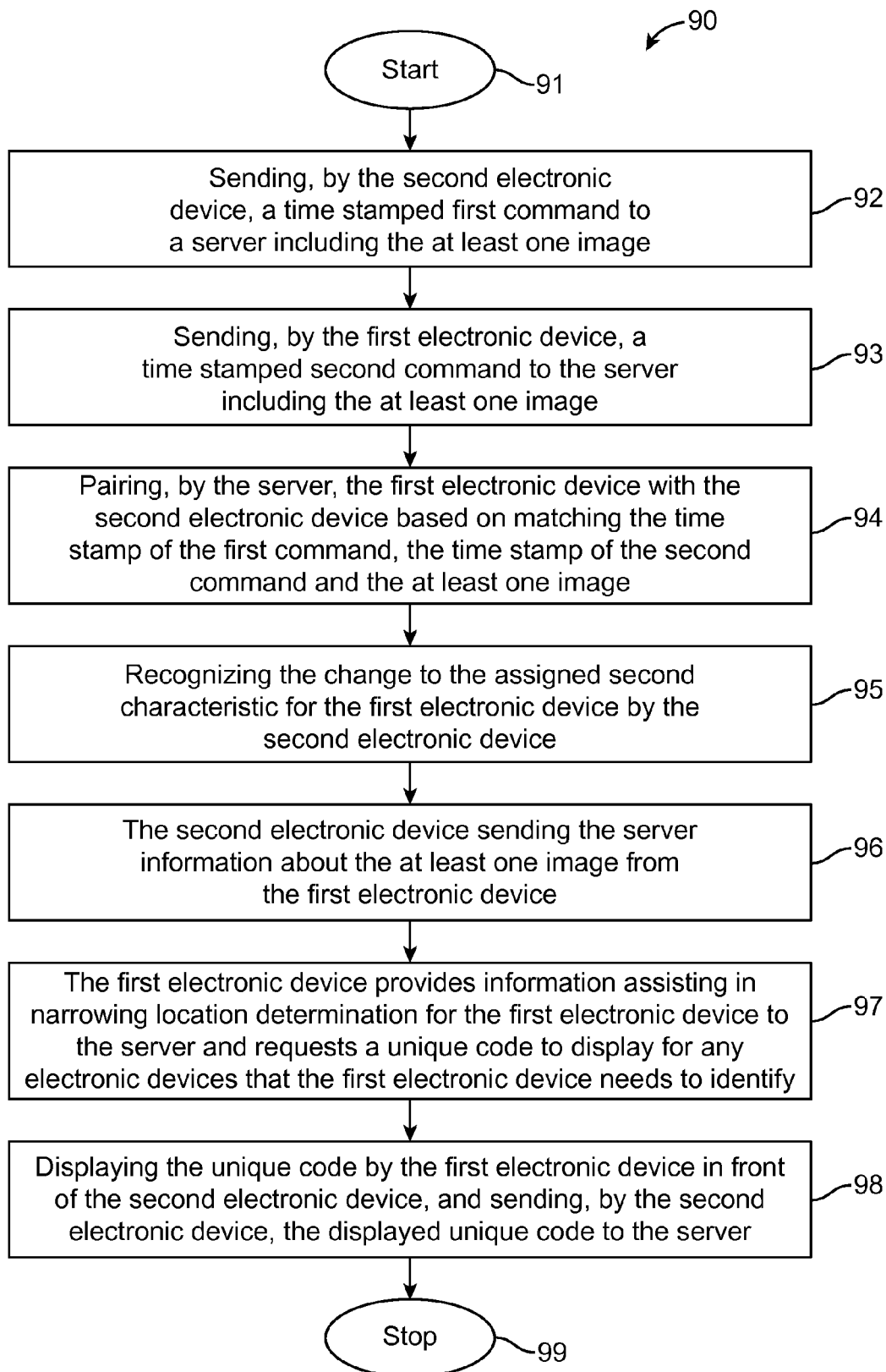


FIG. 14

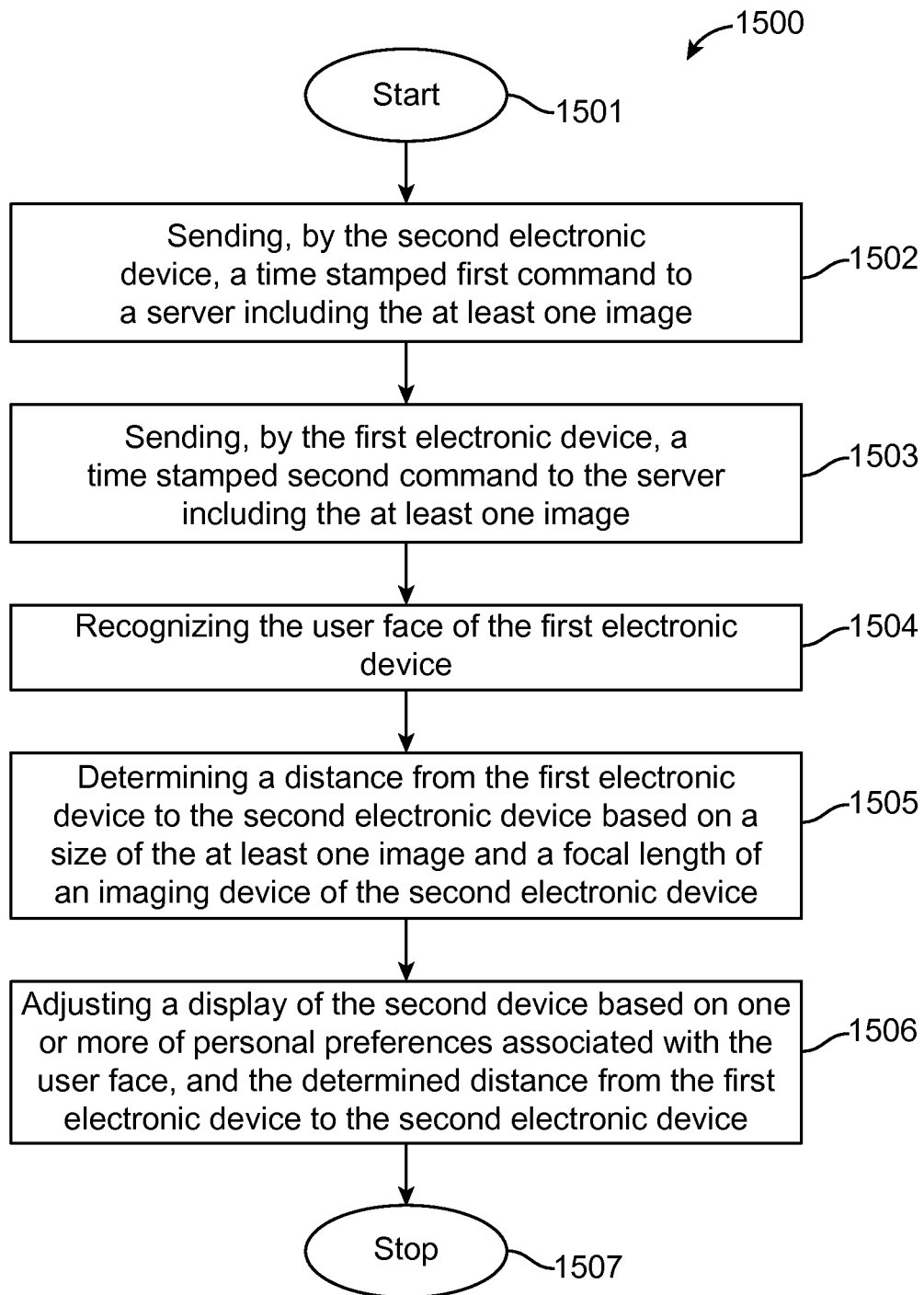


FIG. 15

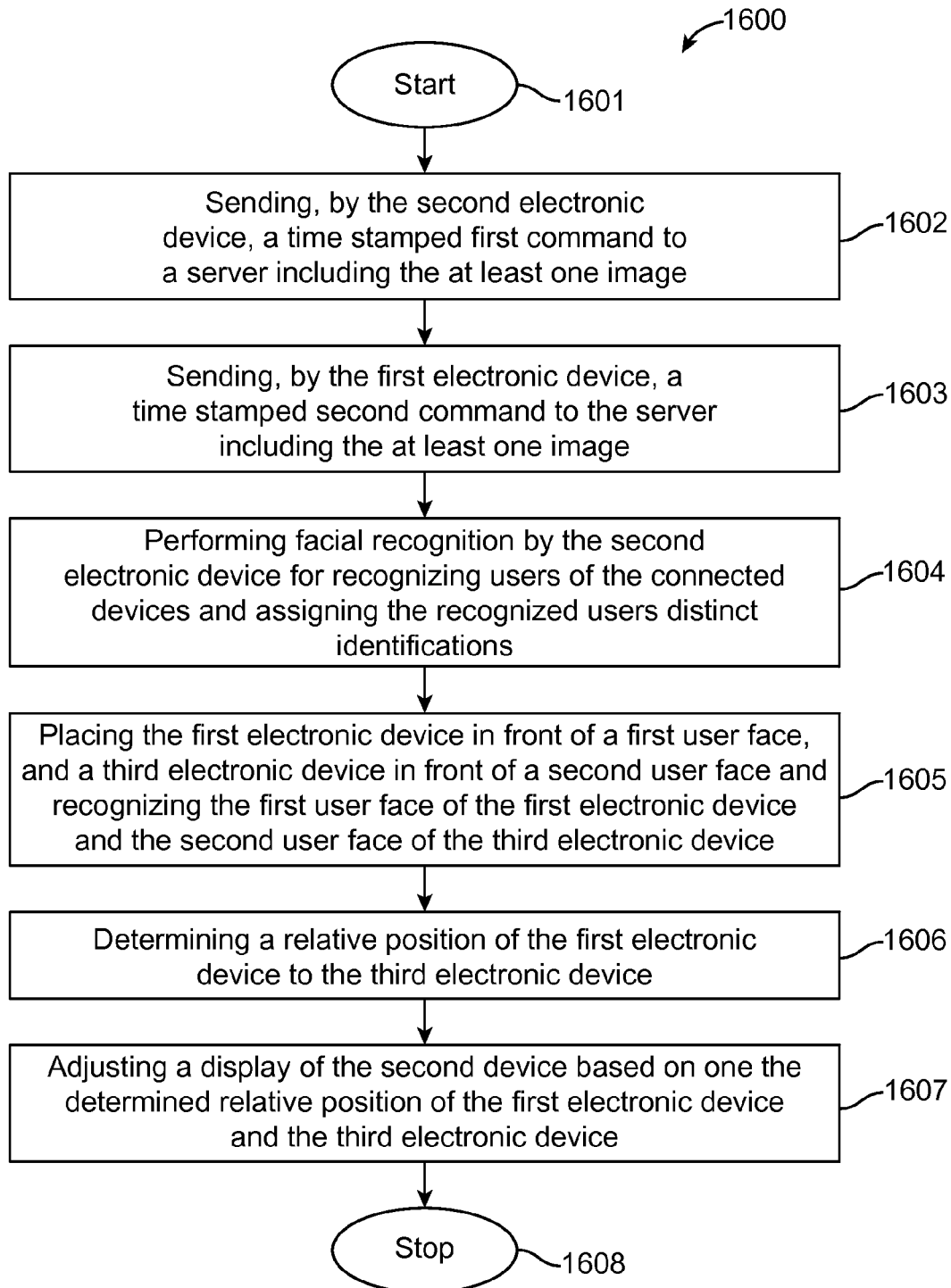


FIG. 16

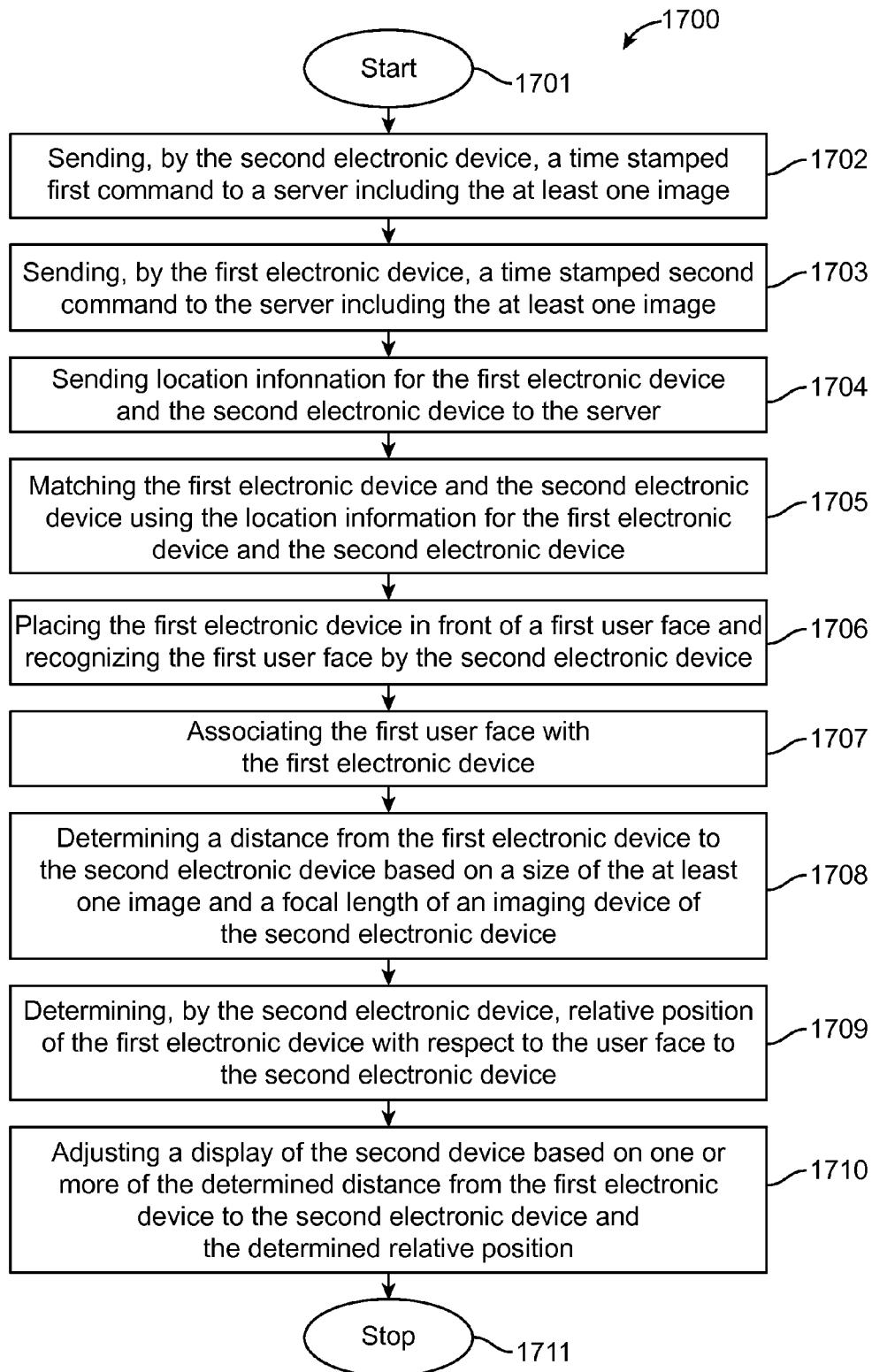


FIG. 17

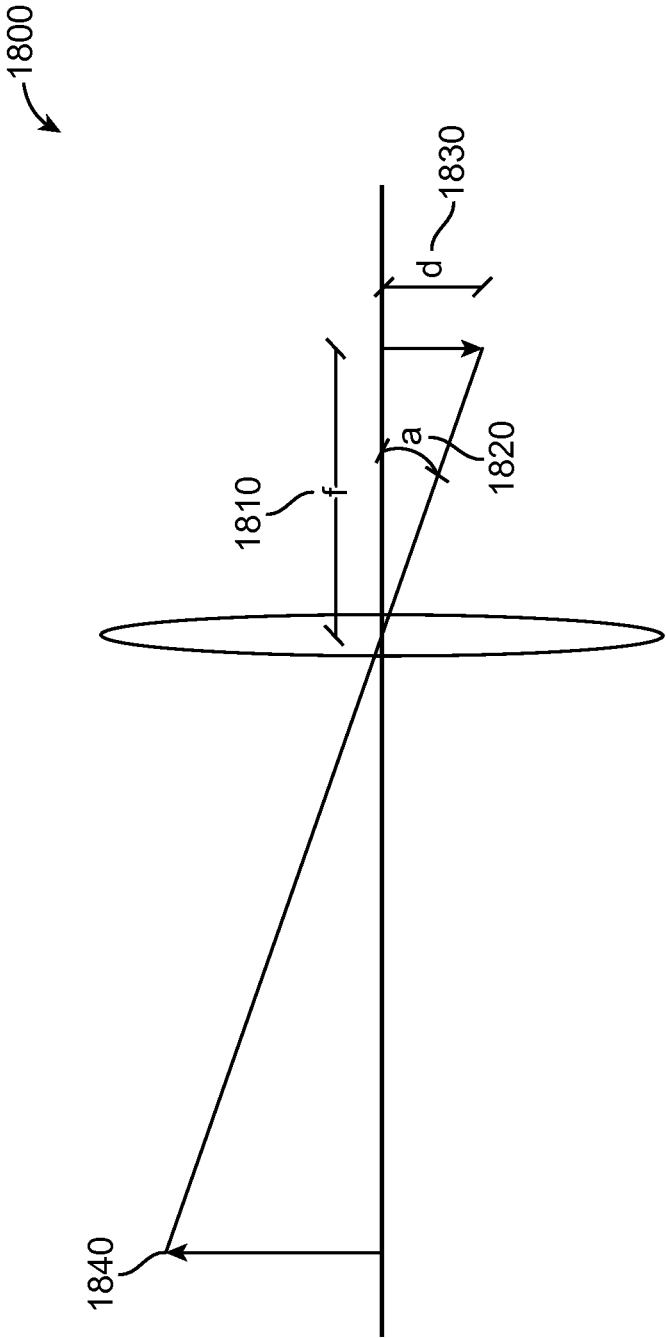


FIG. 18

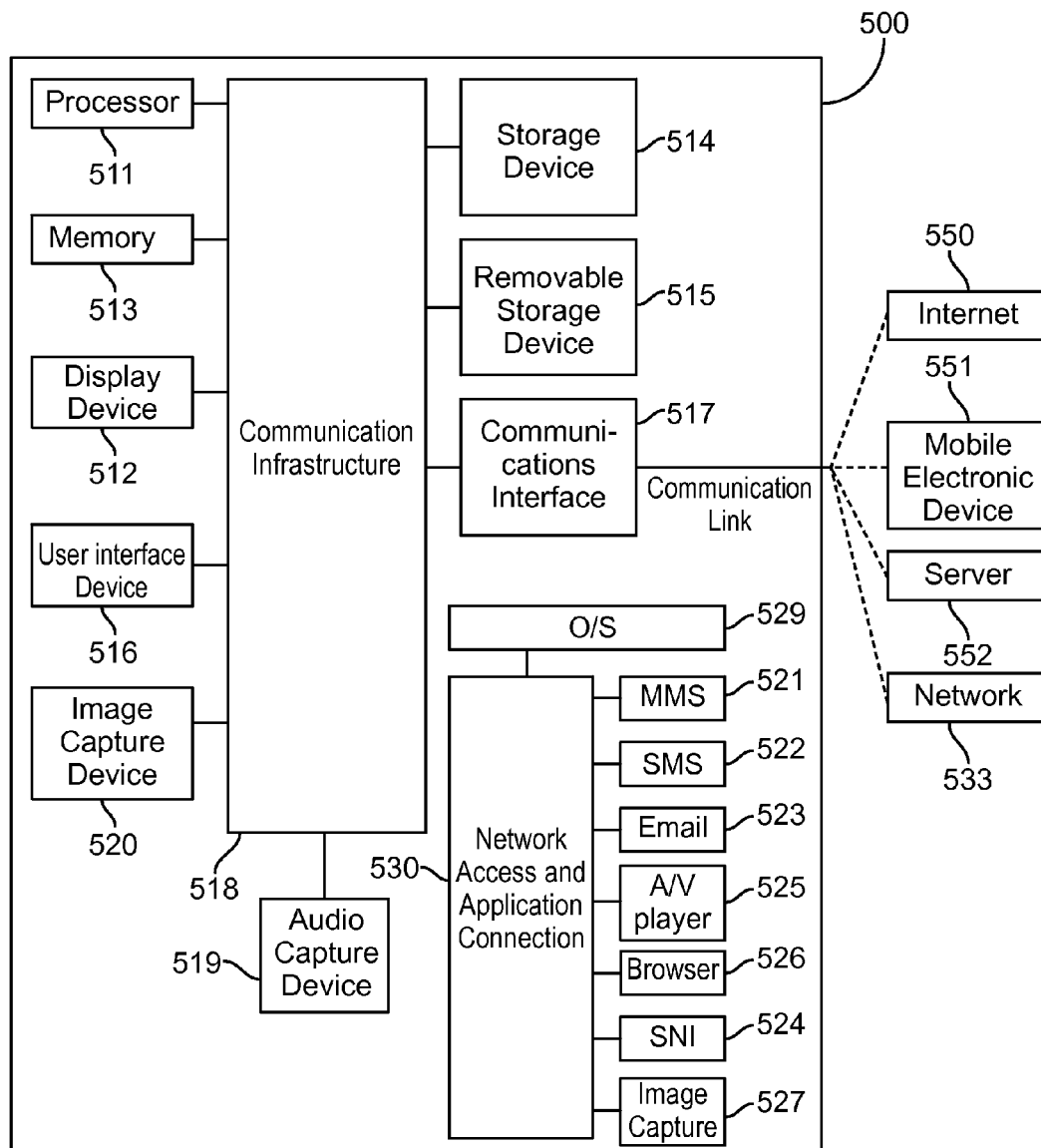


FIG. 19

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DEVICE PAIRING IN A NETWORK

TECHNICAL FIELD

One or more embodiments relate generally to device pairing in a network environment and, in particular, to automated pairing between multiple devices in a network.

BACKGROUND

For pairing a hand-held (HH) device to a television device (TV) within a home (assuming that both of devices are using the same access point (AP)), typically the HH device presents a user with a list of all TV devices on the home network. The user would then have to select one of the devices in the list. The TV devices, however, do not know which user is currently in front of a particular TV device.

SUMMARY

In one embodiment, a method provides for device pairing. In one embodiment, the method includes displaying at least one image having a first characteristic using a first application by a first electronic device. In one embodiment, it is determined if the image is recognizable. In one embodiment, if the image is determined to be recognizable, the first electronic device is paired with a second electronic device.

One embodiment provides a system for pairing devices. One embodiment comprises a first electronic device that displays at least one image having a first characteristic using a first application, and a second electronic device that determines if the image is recognizable and pairs with the first electronic device if the image is determined to be recognizable.

Another embodiment provides a non-transitory computer-readable medium having instructions which when executed on a computer perform a method comprising: displaying at least one image having a first characteristic using a first application by a first electronic device. In one embodiment, it is determined if the image is recognizable. In one embodiment, the first electronic device is paired with a second electronic device if the image is determined to be recognizable.

These and other aspects and advantages of the embodiments will become apparent from the following detailed description, which, when taken in conjunction with the drawings, illustrate by way of example the principles of the embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the nature and advantages of the embodiments, as well as a preferred mode of use, reference should be made to the following detailed description read in conjunction with the accompanying drawings, in which:

FIG. 1 shows a schematic view of a communications system, according to an embodiment.

FIG. 2 shows a block diagram of an architecture for a system for device pairing, according to an embodiment.

FIG. 3 shows an example scenario for device pairing, according to an embodiment.

FIG. 4 shows another example scenario for device pairing, according to an embodiment.

FIG. 5 shows an example flow chart for device pairing, according to an embodiment.

FIG. 6 shows an example scenario for device pairing, according to an embodiment.

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FIG. 7 shows another example flow chart for device pairing, according to an embodiment.

FIG. 8 shows an example scenario for pairing with a user face, according to an embodiment.

FIG. 9 shows an example scenario for determining distance between paired devices, according to an embodiment.

FIG. 10 shows another example flowchart determining distance between paired devices, according to an embodiment.

FIG. 11 shows example scenario for device pairing and device relative location determination and tracking, according to an embodiment.

FIG. 12 shows another example flowchart for device pairing and device relative location determination and tracking, according to an embodiment.

FIG. 13 shows an example timing diagram for device sharing and pairing, according to an embodiment.

FIG. 14 shows another example flowchart for device sharing and pairing, according to an embodiment.

FIG. 15 shows another example flowchart for device pairing, determining distance between the paired devices and adjusting a display based on the pairing, according to an embodiment.

FIG. 16 shows another example flowchart for device pairing, determining distance between multiple paired devices and adjusting a display based on the pairing, according to an embodiment.

FIG. 17 shows another example flowchart for facial pairing, determining distance between paired devices and adjusting a display based on the pairing, according to an embodiment.

FIG. 18 shows another example determination of location of a user relative to a perpendicular from a paired device, according to an embodiment.

FIG. 19 is a high-level block diagram showing an information processing system comprising a computing system implementing an embodiment.

DETAILED DESCRIPTION

The following description is made for the purpose of illustrating the general principles of the embodiments and is not meant to limit the inventive concepts claimed herein. Further, particular features described herein can be used in combination with other described features in each of the various possible combinations and permutations. Unless otherwise specifically defined herein, all terms are to be given their broadest possible interpretation including meanings implied from the specification as well as meanings understood by those skilled in the art and/or as defined in dictionaries, treatises, etc.

One or more embodiments relate generally to device and facial pairing. In one embodiment, a method for device pairing includes displaying at least one image having a first characteristic using a first application by a first electronic device. In one embodiment, it is determined if the image is recognizable. In one embodiment, if the image is determined to be recognizable, the first electronic device is paired with a second electronic device.

In one embodiment, the electronic devices comprise one or more mobile electronic devices capable of data communication over a communication link such as a wireless communication link. Examples of such mobile device include a mobile phone or smart phone device, a mobile tablet device, a wearable device, a mobile computing device, etc.

FIG. 1 is a schematic view of a communications system in accordance with one embodiment. Communications system 10 may include a communications device that initiates an

outgoing communications operation (transmitting/initiator device **12**) and communications network **110**, which transmitting device **12** may use to initiate and conduct communications operations with other communications devices within communications network **110**. For example, communications system **10** may include a communication device that receives the communications operation from the transmitting device **12** (receiving device/listener **11**). Although communications system **10** may include several transmitting devices **12** and receiving devices **11**, only one of each is shown in FIG. 1 to simplify the drawing.

Any suitable circuitry, device, system or combination of these (e.g., a wireless communications infrastructure including communications towers and telecommunications servers) operative to create a communications network may be used to create communications network **110**. Communications network **110** may be capable of providing communications using any suitable communications protocol. In some embodiments, communications network **110** may support, for example, traditional telephone lines, cable television, Wi-Fi (e.g., a 802.11 protocol), Bluetooth®, high frequency systems (e.g., 900 MHz, 2.4 GHz, and 5.6 GHz communication systems), infrared, other relatively localized wireless communication protocol, or any combination thereof. In some embodiments, communications network **110** may support protocols used by wireless and cellular phones and personal email devices (e.g., a Blackberry®). Such protocols can include, for example, GSM, GSM plus EDGE, CDMA, quad-band, and other cellular protocols. In another example, a long range communications protocol can include Wi-Fi and protocols for placing or receiving calls using VOIP or LAN. Transmitting device **12** and receiving device **11**, when located within communications network **110**, may communicate over a bidirectional communication path such as path **13**. Both transmitting device **12** and receiving device **11** may be capable of initiating a communications operation and receiving an initiated communications operation.

Transmitting device **12** and receiving device **11** may include any suitable device for sending and receiving communications operations. For example, transmitting device **12** and receiving device **11** may include a media player, a cellular telephone or a landline telephone, a personal e-mail or messaging device with audio and/or video capabilities, pocket-sized personal computers such as an iPAQ Pocket PC available by Hewlett Packard Inc., of Palo Alto, Calif., personal digital assistants (PDAs), a desktop computer, a laptop computer, and any other device capable of communicating wirelessly (with or without the aid of a wireless enabling accessory system) or via wired pathways (e.g., using traditional telephone wires). The communications operations may include any suitable form of communications, including for example, voice communications (e.g., telephone calls), data communications (e.g., e-mails, text messages, media messages), or combinations of these (e.g., video conferences).

FIG. 2 shows a functional block diagram of an embodiment of an architecture system **100** for application connection by hand held (HH) electronic devices 1-N **140** (N being a positive integer), according to an embodiment. In one embodiment, the system **100** comprises a television device **120** (e.g., a TV, a computer, tablet, etc.), a cloud or server device **130** and network connection device **110**. In one embodiment, the television device **120** comprises a display **121**, a camera or imaging device **122** (either integrated with the TV **120** or separate from the TV **120**), and an application manager module **125** for managing applications, such as application 1 **126**, application 2 **127** up to application N **128**, N being a positive integer.

In one embodiment, the display **121** may be a separate device from the television device **120** or integrated with the television device **120**. In one embodiment, the camera **122** may be a separate device from the television device **120** or integrated with the television device **120**. In one embodiment, the network connection device **110** may comprise a network interface, such as a network modem, router, etc. for handling communications between the television device and the server device **130** and for forming a local network that the television device **120** may be connected with.

In one embodiment, both transmitting device **12** and receiving device **11** may include some or all of the features of electronics devices 1-N **140**. In one embodiment, the electronic devices 1-N **140** may comprise a display **141**, input mechanism **142**, communications circuitry **143**, control circuitry **144**, a camera **145**, and a global positioning system (GPS) receiver module **146**, a microphone, audio output, and any other suitable components.

In one embodiment, all of the applications employed by display **141**, input mechanism **142**, the audio output and communications circuitry **143** may be interconnected and managed by control circuitry **144**. In one example, a hand held music player capable of transmitting music to other tuning devices may be incorporated into the electronics devices 1-N **140**.

In one embodiment, the audio output may include any suitable audio component for providing audio to a user of any of the electronics devices 1-N **140**. For example, the audio output may include one or more speakers (e.g., mono or stereo speakers) built into an electronics device 1-N **140**. In some embodiments, the audio output may include an audio component that is remotely coupled to an electronics device 1-N **140**. For example, the audio output may include a headset, headphones or earbuds that may be coupled to communications device with a wire (e.g., coupled to an electronics device 1-N **150** with a jack) or wirelessly (e.g., Bluetooth® headphones or a Bluetooth® headset).

In one embodiment, display **141** may include any suitable screen or projection system for providing a display visible to the user. For example, display **141** may include a screen (e.g., an LCD screen) that is incorporated in an electronics device 1-N **140**. As another example, display **141** may include a movable display or a projecting system for providing a display of content on a surface remote from an electronics device 1-N **140** (e.g., a video projector). Display **141** may be operative to display content (e.g., information regarding communications operations or information regarding available media selections) under the direction of control circuitry **144**.

In one embodiment, input mechanism **142** may be any suitable mechanism or user interface for providing user inputs or instructions to an electronics device 1-N **140**. Input mechanism **142** may take a variety of forms, such as a button, keypad, dial, a click wheel, or a touch screen. The input mechanism **142** may include a multi-touch screen. The input mechanism may include a user interface that may emulate a rotary phone or a multi-button keypad, which may be implemented on a touch screen or the combination of a click wheel or other user input device and a screen.

In one embodiment, communications circuitry **143** may be any suitable communications circuitry operative to connect to a communications network (e.g., communications network **110**, FIG. 1) and to transmit communications operations and media from an electronics device 1-N **140** to other devices within the communications network. Communications circuitry **143** may be operative to interface with the communications network using any suitable communications protocol such as, for example, Wi-Fi (e.g., a 802.11 protocol), Blue-

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tooth®, high frequency systems (e.g., 900 MHz, 2.4 GHz, and 5.6 GHz communication systems), infrared, GSM, GSM plus EDGE, CDMA, quadband, and other cellular protocols, VOIP, or any other suitable protocol.

In some embodiments, communications circuitry **143** may be operative to create a communications network using any suitable communications protocol. For example, communications circuitry **143** may create a short-range communications network using a short-range communications protocol to connect to other communications devices. For example, communications circuitry **143** may be operative to create a local communications network using the Bluetooth® protocol to couple an electronics device 1-N **140** with a Bluetooth® headset.

In one embodiment, control circuitry **144** may be operative to control the operations and performance of an electronics device 1-N **140**. Control circuitry **144** may include, for example, a processor, a bus (e.g., for sending instructions to the other components of an electronics device 1-N **140**), memory, storage, or any other suitable component for controlling the operations of an electronics device 1-N **140**. In some embodiments, a processor may drive the display and process inputs received from the user interface. The memory and storage may include, for example, cache, Flash memory, ROM, and/or RAM. In some embodiments, memory may be specifically dedicated to storing firmware (e.g., for device applications such as an operating system, user interface functions, and processor functions). In some embodiments, memory may be operative to store information related to other devices with which an electronics device 1-N **140** performs communications operations (e.g., saving contact information related to communications operations or storing information related to different media types and media items selected by the user).

In one embodiment, the control circuitry **144** may be operative to perform the operations of one or more applications implemented on an electronics device 1-N **140**. Any suitable number or type of applications may be implemented. Although the following discussion will enumerate different applications, it will be understood that some or all of the applications may be combined into one or more applications. For example, an electronics device 1-N **140** may include an application connection application, a dialog application, a map application, a media application (e.g., QuickTime, MobileMusic.app, or MobileVideo.app). In some embodiments, an electronics device 1-N **140** may include one or several applications operative to perform communications operations. For example, an electronics device 1-N **140** may include a messaging application, a mail application, a telephone application, a voicemail application, an instant messaging application (e.g., for chatting), a videoconferencing application, a fax application, or any other suitable application for performing any suitable communications operation.

In some embodiments, an electronics device 1-N **140** may include one or more microphones. For example, an electronics device 1-N **140** may include a microphone to allow the user to transmit audio (e.g., voice audio) during a communications operation or as a means of establishing a communications operation or as an alternate to using a physical user interface. A microphone may be incorporated in an electronics device 1-N **140**, or may be remotely coupled to an electronics device 1-N **140**. For example, a microphone may be incorporated in wired headphones, or a microphone may be incorporated in a wireless headset.

In one embodiment, an electronics device 1-N **140** may include any other component suitable for performing a communications operation. For example, an electronics device

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1-N **140** may include a power supply, ports or interfaces for coupling to a host device, a secondary input mechanism (e.g., an ON/OFF switch), or any other suitable component.

In one embodiment, a user may direct an electronics device 1-N **140** to perform a communications operation using any suitable approach. As one example, a user may receive a communications request from another device (e.g., an incoming telephone call, an email or text message, an instant message), and may initiate a communications operation by accepting the communications request. As another example, the user may initiate a communications operation by identifying another communications device and transmitting a request to initiate a communications operation (e.g., dialing a telephone number, sending an email, typing a text message, or selecting a chat screen name and sending a chat request).

In one embodiment, an electronic device 1-N **140** (N being a positive integer) may comprise a mobile device that may utilize mobile device hardware functionality including: the GPS receiver module **146**, the camera **145**, a compass module, and an accelerometer and gyroscope module. The GPS receiver module **146** may be used to identify a current location of the mobile device (i.e., user). The compass module is used to identify direction of the mobile device. The accelerometer and gyroscope module is used to identify tilt of the mobile device.

The system **100** provides the electronic devices 1-N **140** (N being a positive integer) the ability to connect to an application launched on the television device **120**, such as application **1 126**, application **2 127** to application **N 128**. In one embodiment, the application **1 126**, application **2 127** to application **N 128** may comprise software applications executing on the television device **120**, or executing on another device and having a visual display portion of the application shown on the display **121**.

In one embodiment, the local network (e.g., a wireless network) that the television device **120** is connected to is a secured network with a security code (e.g., pass code, password, key code, etc.) providing access to the local network such that without having knowledge of the key code, the electronic devices 1-N **140** cannot pair or join the local network. In one embodiment, access is provided to the electronic devices 1-N **140** to the local network that the application is launched by means for connecting, such as by obtaining information from a server based on location of an electronic device (e.g., electronic devices 1-N **140**), obtaining information from a communication (e.g., text message, email, chat, etc.), etc. In one embodiment, once an electronic device 1-N **140** is connected to the local network, the connection may have a limited life for security purposes (e.g., one hour, two hours, 4 hours, etc.). In one embodiment, the security code may be unique for each session.

FIG. 3 shows an example scenario **300** for device pairing, according to an embodiment. One or more embodiments provide for a user at home to pair their HH electronic device **140** with a TV **120** where there is a possibility of multiple TVs **120** in the household or other environment. In one or more embodiments, in the case the HH device is used by multiple family/community members, the pairing process associates a particular user (e.g., user **320**) with the HH electronic device **140**.

In one embodiment, for scenario **300** it is assumed that multiple TVs **120** and multiple HH electronic devices **140** are present in the environment (e.g., a home environment). In one embodiment, for scenario **300**, the HH electronic device **140** and TV **120** are on the same network (or access point (AP)), which may be a particular home setting and the HH electronic device **140** and TV **120** have been paired. In one embodiment,

it may be assumed for scenario **300** that the TV camera **122** is constantly working (or may be started by a command, such as a voice command, remote control (RC) command, etc.), and the TV camera **122** is able to recognize a characteristic (e.g., color, pattern, shape, etc.) of an image or object (e.g., a blob, design, photograph, pattern, etc.) on the display **141** of the HH electronic device **140**. In one embodiment, for scenario **300** it is assumed that the TV camera **122** and other processing by the TV **120** is able to recognize and keep track of a user face (e.g., via facial recognition techniques).

In one embodiment, scenario **300** identifies which HH electronic device **140** (of multiple HH electronic devices **140**) is desired to be paired with which TV **120** (of multiple TVs **120**). In one embodiment, a guest or user launches an HH convergence application (App), starts a listener (user data-gram protocol (UDP), Universal plug and play (UPnP), etc.), displays a known image **311** (e.g., simple) or series or set of images **310** (e.g., complex) on the display **141** having a first characteristic (e.g., color, shade, pattern, shape, etc.), and the user holds the HH electronic device **140** up to TV camera **122** with the display **141** facing the TV camera **122**. In one example embodiment, the image(s) **310** or **311** may be: a colored blob, simple shape, or shape that may change over time; complex shape, static or dynamic pattern, etc.

In one example embodiment, in the case of the image(s) **310** or **311** being a static color blob or pattern, the TV **120** sends broadcast commands to all HH electronic devices **140** (e.g., connected with the network, e.g., a local area network (LAN), home network, etc.) to change the color of the image(s) **310** or **311** on respective displays **141** to a different but randomly selected characteristic (e.g., color, pattern, shape, etc.), e.g., (HH1→color 1, HH2→color 2 etc.). In one embodiment, a re-change request/command may be sent by the TV **120** in the event that there are more than one HH electronic device **140**, and the more than one HH electronic devices **140** have used/chosen close a characteristic (e.g., colors, shapes, patterns, etc.) for the respective image(s) **310** or **311** as determined by the TV **120** using the TV camera **122**.

In one or more embodiments, either a complex or simple color blob, shape or pattern **311** or a complex or simple series of color blobs, shapes or patterns **310** are based on camera resolution, lightening, distance, etc. In one or more embodiments, if the camera or image sensor is able to recognize a complex color blob, shape or pattern **311** or series **310**, then the number of color changes required to recognize an electronic device **140** may be minimized. If a simple color blob, shape or pattern **311** or series **310** needs to be used, then a larger number of characteristic changes may be needed in order to recognize (or distinguish) an electronic device **140**.

FIG. **4** shows another example scenario **400** for device pairing, according to an embodiment. In one embodiment, the HH electronic device **140** held in front of the TV **120** by a user **320** changes image **411** object characteristic (e.g., color, shade, shape, pattern, etc.) on the display **141** of HH electronic device **140** to the one directed by the TV **120** for identifying which HH electronic device **140** it is (among multiple HH electronic devices **140** with other characteristics for the image **411**). In one embodiment, the HH electronic device **140** changes the characteristic by changing a pattern of an object **411** that identifies which HH electronic device **140** (of multiple HH electronic devices **140**) it is.

FIG. **5** shows an example flow chart for a process **50** for device pairing, according to an embodiment. In one embodiment, the process **50** starts in block **51** (e.g., an HH electronic device **140** turns on, a TV **120** turns on, etc.). In one embodiment, in block **52** an HH electronic device **140** (a first electronic device) launches an application for pairing/associating

the HH electronic device **140** with a TV **120** (second electronic device) in an environment or particular area, such as a home network, LAN, etc. In one embodiment, in block **53**, the HH electronic device **140** displays an image(s) on a display (e.g., display **141**) including a first characteristic (e.g., color, pattern, shape, etc.).

In one embodiment, in block **54**, the TV **120** attempts to recognize the image(s) and first characteristic for the electronic device **140**. In one embodiment, in block **55**, if the TV **120** recognizes the image and first characteristic, the TV **120** and the electronic device **140** pair with one another. In one embodiment, block **56** the pairing process **50** stops, and the application may continue to another step, such as communicate particular messages with between the paired devices, share information between the paired devices, etc.

In one embodiment, process **50** further includes if it is determined that the image and first characteristic is not recognizable or indistinguishable from any other electronic devices **140** in the particular environment or area (e.g., LAN, home network, room, etc.) the HH electronic device **140** (and any other HH electronic devices **140** in the environment) receives a request to change the first characteristic to one or more second characteristic (e.g., color, shade, shape, pattern, etc.) from the TV **120**. In one embodiment, process **50** further includes the HH electronic device **140** (and any other HH electronic devices **140** in the environment) changes the image to have the second characteristic. In one embodiment, a camera of the TV **120** (TV camera **122**) recognizes the change to the second characteristic by the HH electronic device **140**, which has a display **141** placed in front of the TV camera by a user (e.g., user **320**) showing the second characteristic of the image. In one embodiment, the HH electronic device **140** (first electronic device) is now paired with the TV **120** (second electronic device).

FIG. **6** shows an example scenario **600** for device pairing, according to an embodiment. In one embodiment, after the HH electronic device **120** has a characteristic of an image **411** recognized by the TV **120** using the TV camera **122**, the HH electronic device **140** becomes paired **610** with the TV **120**. In one embodiment, the TV **120** may assign the HH electronic device **140** a unique image(s) (e.g., a unique blob) with a uniquely identifiable characteristic (e.g., color, shade, shape, pattern, etc.) for future use, other applications, etc. In one embodiment, the TV **120** may send an acknowledge message (ACK) to the HH electronic device **140** once the second characteristic of the image is recognized by the TV **120**, and the HH electronic device **140** may then continue with the next step on the application being executed or start another application.

FIG. **7** shows another example flow chart for a process **60** for device pairing, according to an embodiment. In one embodiment, process **60** provides for associating a user (e.g., user **320**, FIG. **8**) with a community/shared HH electronic device **140** (FIG. **8**). In one embodiment, process **60** starts in block **61**, where the HH electronic device **140** (first electronic device) turns on, starts an application, etc. and the TV **120** (second electronic device) turns on, starts an application, etc.). In one embodiment, for process **60** it may be assumed that all users' faces have been identified by the TV **120** using the TV camera **122** and the users have been assigned a name/Identification (ID).

In one embodiment, in block **62** the TV **120** performs facial recognition for a user of a connected (to the network, e.g., home network, LAN, etc.) HH electronic device **140**. In one embodiment, in block **63** a recognized user is assigned a distinct ID. In one embodiment, in block **64** a user places an HH electronic device **140** in front of the user's face. In one

embodiment, in block 65 the TV 120 recognizes the user face in front of the HH electronic device 140.

In one embodiment, in block 66, the TV 120 determines the distance from the HH electronic device 140 to the TV 120. In one embodiment, in block 67 the TV 120 associates with the HH electronic device 140 or associates with the user face of the HH electronic device 140. In one embodiment, the process 60 stops at block 68, where the application may proceed to a next step for communication between the HH electronic device 140 and the TV 120, or communicate using another application, etc.

FIG. 8 shows an example scenario 700 for pairing with a user 320 face, according to an embodiment. In one embodiment, for scenario 700 it is assumed that multiple TVs 120 and multiple HH electronic devices 140 are present in the environment (e.g., a home environment). In one embodiment, for scenario 700, the HH electronic device 140 and TV 120 are on the same network (or AP), which may be a particular home setting and the HH electronic device 140 and TV 120 have been paired. In one embodiment, it may be assumed for scenario 700 that the TV camera 122 is constantly working (or may be started by a command, such as a voice command, RC command, etc.), and the TV camera 122 is able to recognize a characteristic (e.g., color, pattern, shape, etc.) of an image or object (e.g., a blob, design, photograph, pattern, etc.) on the display 141 of the HH electronic device 140. In one embodiment, for scenario 700 it is assumed that the TV camera 122 and other processing by the TV 120 is able to recognize and keep track of a user face (e.g., via facial recognition techniques). In one embodiment, it is also assumed that all users' faces have been identified by the TV 120 and have been assigned a particular name/ID.

In one embodiment, in scenario 700 a user 320 holds up the HH electronic device 140 close to their face and starts a convergence App. In one embodiment, the App displays an image 411 having a first characteristic (e.g., color, shape, pattern, etc.), such as a colored blob, on the display 141 of the HH electronic device 140. In one embodiment, the TV 120 sends commands to all HH electronic devices 140 in the environment (e.g., in the home network, LAN, etc.) to change the first characteristic to a second characteristic (e.g., color, shape, pattern, etc.) that is a different, but randomly selected characteristic, e.g., color (HH1→color 1, HH2→color 2 etc.).

In one embodiment, all of the HH electronic devices 140 change to a second characteristic, such as change of color of the image, as directed by the TV 120. In one embodiment, based on the new characteristic that the TV camera 122 now observes, the TV 120 identifies the HH electronic device 140 in front of the TV 120. In one embodiment, the TV 120 recognizes the characteristic change and sends a command to the HH electronic device 140 to move to the next step in the App. In one embodiment, the TV 120 recognizes the face closest to the HH electronic device 140. Once the user 320 face is recognized by the TV 120, the HH electronic device 140 is associated to the face (or user 320), which is paired with the TV 120 as shown by the arrow 710.

FIG. 9 shows an example scenario 800 for determining distance 810 between paired devices, according to an embodiment. In one embodiment, determining the relative distance of the user 320 with respect to the TV 120 may be useful to determine display characteristics, such as the font size, personal preferences, etc. In one embodiment, for scenario 800 it is assumed that multiple TVs 120 and multiple HH electronic devices 140 are present in the environment (e.g., a home environment). In one embodiment, for scenario 800, the HH electronic device 140 and TV 120 are on the same network (or AP), which may be a particular home setting and

the HH electronic device 140 and TV 120 have been paired. In one embodiment, it may be assumed for scenario 800 that the TV camera 122 is constantly working (or may be started by a command, such as a voice command, RC command, etc.), and the TV camera 122 is able to recognize a characteristic (e.g., color, pattern, shape, etc.) of an image or object (e.g., a blob, design, photograph, pattern, etc.) on the display 141 of the HH electronic device 140. In one embodiment, for scenario 800 it is assumed that the TV camera 122 and other processing by the TV 120 is able to recognize and keep track of a user face (e.g., via facial recognition techniques). In one embodiment, it is also assumed that all users' faces have been identified by the TV 120 and have been assigned a particular name/ID.

In one embodiment, in scenario 800 a user 320 holds up the HH electronic device 140 close to their face and starts the convergence App. In one embodiment, the App shows a fixed size image (e.g., an object, a blob, etc.) with a first characteristic (e.g., color, shape, pattern, etc.), which is associated with the HH electronic device 140. In one embodiment, the TV 120 sends commands to all HH electronic devices 140 (connected in the environment) to change the first characteristic to a second characteristic (e.g., color, shape, pattern, etc.), which is different from the first characteristic but randomly selected, e.g., color (HH1→color 1, HH2→color 2 etc.).

In one embodiment, the HH electronic device 140 in front of TV 120 changes the image 411 to the second characteristic (e.g., blob color) to the second characteristic directed by the TV 120 for identifying which HH electronic device 120 it is. In one embodiment, the TV 120 recognizes the characteristic change and sends a command to the HH electronic device 140 to move to the next App step. In one embodiment, since the HH electronic device 140 shows a fixed size image with the second characteristic on the display 141, the TV 120 may determine the distance 810 based on the size of the image 411 as seen by TV camera 122.

In one example embodiment, the distance 810 of the HH electronic device 140 from the TV 120 may be equal to the diameter of the image (e.g., circle (blob)) shown on the display 141 of the HH electronic device 140, divided by the diameter of the image (e.g., a circle) seen by the TV camera 122 multiplied by the focal length of the TV camera 122 lens (e.g., Distance=Camera focal length*(diameter of the HH circle/diameter of the image circle)). In one embodiment, if the user 320 is holding a personal HH electronic device 140, the TV 120 is now paired to the HH electronic device 140 (and therefore, paired to the user 320). In one embodiment, if the user 320 is holding a personal communal HH electronic device 140, the TV 120 recognizes the face closest to the HH electronic device 140, and from there on, the HH electronic device 140 is associated to the particular closest face (or user).

FIG. 10 shows another example flowchart of a process 70 for determining distance between paired devices, according to an embodiment. In one embodiment, process 70 starts in block 71, where the HH electronic device 140 (first electronic device) turns on, starts an application, etc. and the TV 120 (second electronic device) turns on, starts an application, etc.). In one embodiment, for process 70 it may be assumed that all users' faces have been identified by the TV 120 using the TV camera 122 and the users have been assigned a name/Identification (ID).

In one embodiment, in block 72 the TV 120 performs facial recognition for a user of a connected (to the network, e.g., home network, LAN, etc.) HH electronic device 140. In one embodiment, in block 73 a recognized user is assigned a distinct ID. In one embodiment, in block 74 a user places an HH electronic device 140 in front of the user's face. In one

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embodiment, in block 75 the TV 120 recognizes the user face in front of the HH electronic device 140.

In one embodiment, in block 76, the TV 120 determines the distance from the first HH electronic device 140 to a second HH electronic device 140, where both are in front of the TV 120. In one embodiment, in block 77 the first HH electronic device 140 is associated with the second HH electronic device 140, or the user face of the first electronic device 140 is associated with a second user face of the second HH electronic device 140. In one embodiment, the process 70 stops at block 78, where the application may proceed to a next step for communication between the first and second HH electronic device 140 and the TV 120, or communicate using another application, etc.

FIG. 11 shows example scenario 900 for device pairing and device relative location determination and tracking, according to an embodiment. In one embodiment, the scenario 900 determines the relative position of two (or more) persons (e.g., user 320 and user 920). In one embodiment, scenario 900 is useful for multiplayer games where relative position of players is important (example car racing, card games, etc.). In one embodiment, for scenario 900 it is assumed that multiple TVs 120 and multiple HH electronic devices 140 are present in the environment (e.g., a home environment). In one embodiment, for scenario 900, the HH electronic device 140 and TV 120 are on the same network (or AP), which may be a particular home setting and the HH electronic device 140 and TV 120 have been paired. In one embodiment, it may be assumed for scenario 900 that the TV camera 122 is constantly working (or may be started by a command, such as a voice command, RC command, etc.), and the TV camera 122 is able to recognize a characteristic (e.g., color, pattern, shape, etc.) of an image or object (e.g., a blob, design, photograph, pattern, etc.) on the display 141 of the HH electronic device 140. In one embodiment, for scenario 900 it is assumed that the TV camera 122 and other processing by the TV 120 is able to recognize and keep track of a user face (e.g., via facial recognition techniques). In one embodiment, it is also assumed that all users' faces have been identified by the TV 120 and have been assigned a particular name/ID. In one embodiment, in scenario 900 it may be assumed that the players (e.g., users 320 and 920) are using communal HH electronic device 140 device (e.g., a game controller) or a personal HH electronic device 140 (e.g., personal game controller).

In one embodiment, scenario 900 is an extension of scenario 800 where each user 320 and 920 is paired with a specific HH electronic device 140, as indicated by the arrows 930 and 940. In one example embodiment, once the two HH electronic devices 140 are paired with one another (or the user's 320 and 920 faces are associated), then the TV 120 may follow each user by using the TV camera 122 and keep track of the users 320 and 920 relative location. In one embodiment, the TV 120 using the TV camera 122 determines the relative distance between the two users 320 and 920, and content shown on the TV 120 may be tailored to the users 320 and 920 based on their particular location relative to one another, such as personal information related to a game, content related to a program or application, content based on personal profiles of each user 320 and 920, etc.

FIG. 12 shows another example flowchart of a process 80 for device pairing and device relative location determination and tracking, according to an embodiment. In one embodiment, process 80 starts in block 81, where an HH electronic device 140 (first electronic device) and another HH electronic device 140 (third electronic device) turns on, starts an application, etc. and the TV 120 (second electronic device) turns

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on, starts an application, etc.). In one embodiment, for process 80 it may be assumed that all users' faces have been identified by the TV 120 using the TV camera 122 and the users have been assigned a name/ID.

In one embodiment, in block 82 the TV 120 performs facial recognition for a user of the first and second connected (to the network, e.g., home network, LAN, etc.) HH electronic devices 140 (first and third electronic devices). In one embodiment, in block 83 the recognized users of the two HH electronic devices are assigned distinct IDs. In one embodiment, in block 84 a user of the first HH electronic device 140 (first electronic device) and the user of the second HH electronic device 140 (third electronic device) places the respective HH electronic device 140 in front of the respective user face. In one embodiment, in block 85 the TV 120 recognizes the user's faces in front of each HH electronic device 140.

In one embodiment, in block 86, the first user face is associated with the first HH electronic device 140 (first electronic device) and the second user face is associated with the second HH electronic device 140 (third electronic device). In one embodiment, in block 87 the TV 120 determines the relative position between the first HH electronic device 140 and the second HH electronic device 140, where both are in front of the TV 120. In one embodiment, in block 88 the TV 120 using the TV camera 122 follows movement of the first HH electronic device 140 and the second HH electronic device 140. In one embodiment, the process 80 stops at block 89, where the application may proceed to a next step for communication between the first and second HH electronic device 140 and the TV 120, or communicate using another application, etc.

FIG. 13 shows an example timing diagram 1000 for device sharing and pairing, according to an embodiment. In one embodiment, to easily access a Wi-Fi network from a HH electronic device 140 in a semi-trusted domain (e.g., friend's residence, organization environment, etc.), where the host does not want to give their AP service set identifier (SSID) and password to the guest. One or more embodiments make it easy for the guest if they want to connect to a TV 120 for a convergence App (e.g., a multiplayer gaming app, etc. One or more embodiments determines the relative position of the HH electronic device 140 user (e.g., user 320/920) with respect to the TV 120 by using the TV camera 122, which may be used to determine relative location of multiple users or for pointing to a device using the HH electronic device 140.

In one embodiment, a guest in the semi-trusted environment using an HH electronic device 140 does not know the host AP SSID and password. In one embodiment, there are multiple TVs 120 in the host home (note that if there is only one TV 120, selecting a TV 120 from a list becomes easier). In one embodiment, there are multiple guests with HH electronic devices 140 at the host home. In one embodiment, the host TV 120 and guest HH electronic device 140 are not been paired. In one embodiment, the TV 120 uses the TV camera 122 for recognizing an image on a display 141 of HH electronic devices 140 when held in front of the TV camera 122. In one embodiment, the TV 120 may identify a user 320/920 (FIG. 11) and assign the user an ID. In one embodiment, the TV 120 may recognize and match a previously identified user.

In one embodiment, once the TV 120 recognizes the users of HH electronic devices 140 (e.g., user 320 and user 920, FIG. 11) based on image and characteristic recognition and/or facial recognition, the TV 120 sends the AP SSID and password to the HH electronic device(s) 140, which may be able to share the AP SSID with other HH electronic devices 140 if permitted by the host.

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In one example embodiment, using the timing diagram 1000, a guest HH electronic device 140 is provided with the host AP SSID and password. In one example, assuming that it is desired to launch a convergence App, the guest HH electronic device 140 also desires to pair with host TV 120. In one embodiment, the Host device (e.g., TV 120) launches a TV convergence App (e.g., a shareable App). In one embodiment, the guest launches an HH electronic device 140 convergence App, which shows a known image or series of images with a first characteristic (e.g., color, shape, pattern, etc.), and the user holds the HH electronic device with the display 141 facing the TV camera 122.

In one embodiment, the TV 120 recognizes the image and first characteristic, and sends a time stamped command (e.g., "New HH found") to a server (e.g., server 130, FIG. 2) with the captured image as seen by the TV camera 122. In one embodiment, the HH electronic device 140 sends a time stamped command (e.g., "Showing") to the same server with what it displayed on the display 141. In one embodiment, the server matches the TV 120 and the HH electronic device 140 based on the time stamp and displayed image/objects.

In one embodiment, it is possible that there is more than one TV 120 or HH electronic device 140 that is matched (e.g., more than 2 commands sent in a time window). In one embodiment, there are multiple options to narrow down the list of potential matches and reduce potential false positives. In one embodiment, both the TV 120 and the HH electronic device 140 send out their respective location (or approximation thereof) using, for example, GPS, known information, text information of a known location, etc., which narrows down the search space. In one embodiment, assuming that the host sends out an invitation to all the guests (e.g., email, text message, etc.), the "party" information (e.g., email addresses) may be stored in the server. In one example embodiment, when the "New HH found" and "Showing" commands reach the server, the server may pair HH electronic devices 140 based on the party (host TV 120 and guest HH electronic device 140).

In one example embodiment, each HH electronic device 140 shows a random selected image with a characteristic (e.g., a color, shape, pattern, etc.) on a respective display 141. In one embodiment, the TV 120 recognizes the image and characteristic, and informs the server regarding the image and characteristic.

In one example embodiment, the wireless APs in the vicinity of the HH electronic devices 140 may be matched against the ones the TV 120 is distributing credentials for using the SSID, BSSID or other uniquely identifying information along with signal strength. The one or more example embodiments assist in reducing the list of potential TV 120 ↔ HH electronic device 140 pairing options.

In one or more embodiments, to resolve remaining multiple matches the following may be done. In one example embodiment, the TV 120 sends commands to all HH electronic devices 140 (via the server) that are candidates for the pairing. In one example embodiment, the "Change" command is used to change a characteristic (e.g., color, shape, pattern, etc.) to a different but randomly selected characteristic (e.g., HH1 → color 1, HH2 → color 2 etc.). In one embodiment, the TV 120 recognizes the change of the characteristic for the HH electronic device 140 in front of the TV camera 122 and sends this information to the server.

In one embodiment, the HH electronic device 140 narrows its location, and then requests from the server a unique code (e.g., a simple or complex: color blob, shape, pattern, etc. with a characteristic (e.g., color, shade, etc.)) to display for this subset of devices it must also identify. In one example

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embodiment, the HH electronic device 140 then displays code to the TV 120. In one example embodiment, the TV 120 then sends to the server what the TV camera 122 captured from the HH electronic device 140.

In one example embodiment, the TV 120 then sends the AP SSID and password to the server along with its name, which may be set in the App or via the TV 120. In one embodiment, the AP SSID and password are auto-populated if the TV 120 is wirelessly connected. In one embodiment, the server identifies the HH electronic device 140 based on the color reported by the TV and sends the AP SSID, password, and TV name to it. In one example embodiment, the HH electronic device 140 applies these AP settings for connecting with the TV 120 for sharing the App (e.g., Party App, etc.). In one example embodiment, the AP settings information is encrypted so that the user cannot access it. In one example embodiment, to confirm that Wi-Fi settings were correctly applied, there may be another communication session between the TV 120 and the HH electronic device 140 over Wi-Fi. In one example embodiment, the TV 120 sends an ACK to the HH electronic device 140 and the HH electronic device 140 now continues with the next step on the App. In one example embodiment, the GPS on the HH electronic device 140 may be used to determine the TV's 120 location for future use.

In one embodiment, the TV 120 is able to select the HH electronic device 140 in front of it from other HH electronic devices 140 that might be eligible and vice versa (i.e. the HH electronic device 140 may select the TV 120 which it is in front of) depending on which device initiates the discovery. One or more embodiments fall into three categories: Time multiplexed: The image characteristic on the HH electronic device 140 changes in response to the TV 120 (or server) command and the search space is reduced progressively. In one example embodiment, this approach allows for low fidelity camera and simple image detection algorithms, but takes more time since the characteristic may have to change multiple times before the HH electronic device 140 is uniquely identified; Code multiplexed: The image that is shown on the HH electronic device 140 is made up of complex shapes and various characteristics (e.g., colors) which carries more information and makes it more likely to be unique. In one embodiment, this approach forces the TV 120 to have a high fidelity TV camera 122 and more complex image detection algorithms but reduces the time it takes to uniquely identify the HH; Location multiplex: These approaches limit the number of HH electronic devices 140 that may connect to a TV 120 (reduce the search space). This may be achieved by: Using GPS so that the HH electronic device 140 only searches for a TV 120 in the neighborhood; or Using an invite from a party host to limit only the guest HH electronic device 140 to connect to the party host TV 120. In one embodiment, these techniques may be used individually or in conjunction with each other to solve the search space reduction problem. In one example embodiment, the technique used depends on the camera fidelity and algorithm technology implemented on the TV 120.

In one example embodiment, the relative distance of the user of an HH electronic device 140 with respect to the TV 120 is determined. In one embodiment, this determination is useful to determine the font size, personal preferences, etc. In one example embodiment, all users' faces have been identified by the TV 120 and they have been assigned a name/ID. In one embodiment, the HH electronic devices 140 may be paired with the one or more embodiments described above.

In one embodiment, the relative position of two (or more) persons based on the HH electronic devices 140 may be

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determined. In one example embodiment, this is useful for multiplayer games where relative position of players is important (e.g., car racing video games, card games, etc.). In one example embodiment, all user faces have been identified by the TV 120 and they have been assigned a name/ID. In one example embodiment, the players are using a communal HH electronic device 140 (e.g., a communal game controller) or a personal HH device electronic device 140 (e.g., a personal game controller). In one example embodiment, this scenario may be implemented in the same way as described above in one or more embodiments.

FIG. 14 shows another example flowchart for a process 90 device sharing and pairing, according to an embodiment. In one embodiment, process 90 starts in block 91, where an HH electronic device 140 (first electronic device) turns on, starts an application, etc. and the TV 120 (second electronic device) turns on, starts an application, etc.). In one embodiment, for process 90 it may be assumed that all users' faces have been identified by a TV 120 using a TV camera 122 and the users have been assigned a name/ID.

In one embodiment, in block 92 the TV 120 sends a time-stamped command to a server (e.g., server 130, FIG. 2) including an image with a first characteristic (e.g., color, shape, pattern, etc.) that was captured from an HH electronic device 140 display 141 using a TV camera 122. In one embodiment, in block 93 the HH electronic device 140 sends a time-stamped command to the server including the image displayed using the display 141. In one example embodiment, in block 94, the server pairs the HH electronic device with the TV 120 based on matching the received images and the commands including time-stamps from the TV 120 and the HH electronic device 140.

In one example embodiment, in block 95 the TV 120 recognizes a characteristic change to the image displayed by the HH electronic device 140. In one example embodiment, in block 96 the TV 120 sends the server information about the image and changed characteristic as captured from the HH electronic device 140 using the TV camera 122. In one example embodiment, in block 97 the HH electronic device 140 provides information assisting in narrowing location determination (e.g., GPS, text including location information, etc.) of the HH electronic device 140 to the server and requests a unique code (e.g., simple or complex: color blob, shape, pattern, etc., with a characteristic (e.g., color, shade, etc.)) to display for any devices that the HH electronic device 140 needs to identify.

In one example embodiment, in block 98 the HH electronic device 140 receives the unique code and displays the unique code in front of the TV 120, which uses the TV camera 122 to capture the unique code, where the TV 120 sends the unique code to the server. In one embodiment, the process 90 stops at block 99, where the application may proceed to a next step for communication between the HH electronic device 140 and the TV 120, or communicate using another application, etc.

FIG. 15 shows another example flowchart for a process 1500 for device pairing, determining distance between the paired devices and adjusting a display based on the pairing, according to an embodiment. In one embodiment, process 1500 starts in block 1501, where an HH electronic device 140 (first electronic device) turns on, starts an application, etc. and the TV 120 (second electronic device) turns on, starts an application, etc.). In one embodiment, for process 1500 it may be assumed that all users' faces have been identified by a TV 120 using a TV camera 122 and the users have been assigned a name/ID.

In one embodiment, in block 1502 the TV 120 sends a time-stamped command to a server (e.g., server 130, FIG. 2)

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including an image with a first characteristic (e.g., color, shape, pattern, etc.) that was captured from an HH electronic device 140 display 141 using a TV camera 122. In one embodiment, in block 1503 the HH electronic device 140 sends a time-stamped command to the server including the image displayed using the display 141. In one example embodiment, in block 1504, the TV 120 recognizes a user face of the HH electronic device 140.

In one example embodiment, in block 1505 the TV 120 determines the distance from the HH electronic device 140 to the TV 120 based on a size of the image displayed on the display 141 of the HH electronic device 140, the size of the captured image by the TV camera 122 and the focal length of the TV camera 122. In one example embodiment, in block 1506, the display of the TV 120 is adjusted based on one or more personal preferences associated with the user face of the HH electronic device 140 and the determined distance between the HH electronic device and the TV 120.

In one embodiment, the process 1500 stops at block 1507, where the application may proceed to a next step for communication between the HH electronic device 140 and the TV 120, or communicate using another application, etc.

FIG. 16 shows another example flowchart for a process 1600 for device pairing, determining distance between multiple paired devices and adjusting a display of a TV 120 based on the pairing, according to an embodiment. In one embodiment, process 1600 starts in block 1601, where a first HH electronic device 140 (first electronic device) and a second HH electronic device 140 (third electronic device) turns on, starts an application, etc. and the TV 120 (second electronic device) turns on, starts an application, etc.). In one embodiment, for process 1600 it may be assumed that all users' faces have been identified by a TV 120 using a TV camera 122 and the users have been assigned a name/ID.

In one embodiment, in block 1602 the TV 120 sends a time-stamped command to a server (e.g., server 130, FIG. 2) including images with first characteristics (e.g., color, shape, pattern, etc.) that were captured from the first and second HH electronic devices 140 displays 141 using a TV camera 122. In one embodiment, in block 1603 the first and second HH electronic devices 140 send time-stamped commands to the server including the respective images displayed using the respective displays 141. In one example embodiment, in block 1604, the TV 120 performs facial recognition for recognizing user faces of the connected HH electronic devices 140 (e.g., the first and second HH electronic devices 140).

In one example embodiment, in block 1605 the user of the first HH electronic device 140 and the user of the second HH electronic device 140 place the respective HH electronic devices 140 in front of the respective user faces. In one embodiment, the TV 120 recognizes the faces of each user of each HH electronic device 140.

In one embodiment, in block 1606 the TV 120 determines the relative position (similarly as for the one or more embodiments described above) of the first HH electronic device 140 as compared with the second HH electronic device 140. In one example embodiment, in block 1607, the display of the TV 120 is adjusted based on the determined relative position of the first and second HH electronic devices 140.

In one embodiment, the process 1600 stops at block 1608, where the application may proceed to a next step for communication between the first and second HH electronic devices 140 and the TV 120, or communicate using another application, etc.

FIG. 17 shows another example flowchart for a process 1700 for facial pairing, determining distance between paired devices and adjusting a display based on the pairing, accord-

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ing to an embodiment. One or more embodiments provide for easy pairing of a personal HH electronic device **140** with a communal fixed device (TV **120** and TV camera **122**) in a Campus Area Network (CAN) or Metropolitan Area Network (MAN) to exchange information. One or more embodiments, easily and accurately identify a location of an HH electronic device **140** in a closed space where GPS, Wi-Fi and other location identification methods may not work accurately (e.g., due to reception issues, interference, jamming, etc.).

In one or more embodiments, HH electronic devices **140** are paired in an un-trusted CAN/MAN Wi-Fi network (e.g., airports, schools, malls, etc.) for accurately identifying location. It is noted that pairing is not an issue if AP SSID and password are available (or can be guessed), but accurately identifying the location of an HH electronic device **140** in the absence of specific information (e.g., GPS information) may be an issue. One or more embodiments locate the HH electronic device **140** within line-of-sight and in the neighborhood of a TV camera **122** that is mounted on a TV (or computer), or just buy itself.

In one or more embodiments, incorporating local pairing, or semi-trusted domain pairing embodiments as described above, a user is provided the same user experience for pairing devices regardless of where they are situated (e.g., home, home of a friend, public place, etc.). In one example embodiment, devices are paired and position of an HH electronic device **140** is accurately located without having to be in the physical proximity of a fixed communal device (e.g., NFC reader, QR code reader, etc.). One or more embodiments provide for personalized (or changing) information to be shared between devices, which is not possible with NFC or QR codes.

In one or more embodiments, the CAN or MAN environment (e.g., mall, airport, colleges, etc.) AP with or without repeater and TV (or camera) owner/controller allows a user of an HH electronic device **140** to be on the same network, which may be typically true (e.g., airport, malls, hotels, college campus, etc.). In one example embodiment, multiple TVs **120** and multiple HH electronic devices **140** exist in an un-trusted CAN/MAN domain. In one example embodiment, the user of an HH electronic device **140** does not know a host AP SSID and password (even though it might be easily available). In one example embodiment, the host TV **120** and guest HH electronic device **140** have not been paired. In one example embodiment, it is assumed that the TV camera **122** is constantly working (or may be started by a command) and is able to recognize an image with a characteristic (e.g., color, shape, pattern, etc.) on the HH (electronic device **140**).

In one or more embodiments, a user of an HH electronic device **140** is provided with a CAN/MAN AP SSID and password. In one embodiment, the user desires to launch a convergence App, and also desires to pair with CAN/MAN TV **120**. In one embodiment, the process **1700** starts in block **1701**, where an HH electronic device **140** (first electronic device) turns on, starts an application (e.g., convergence App), etc. and the TV **120** (second electronic device) turns on, starts an application, etc.).

In one embodiment, in block **1702** the TV **120** sends a time-stamped command to a server (e.g., server **130**, FIG. 2) including an image with a first characteristic (e.g., color, shape, pattern, etc.) that was captured from the HH electronic device **140** display **141** using a TV camera **122**. In one embodiment, in block **1703** the HH electronic device **140** sends a time-stamped command to the server including the image displayed using the display **141**. In one embodiment, in block **1704** if location information is available (e.g., GPS

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signals, Wi-Fi, etc.), the HH electronic device **140** and TV **120** send the location information to the server.

In one embodiment, in block **1705** the server matches the location information of the HH electronic device **140** and the TV **120** using the location information received from each device. In one embodiment, multiple HH electronic devices **140** and multiple TVs **120** send their respective location information, which is then matched by the server to determine which HH electronic device **140** is in front or near to which TV **120**.

In one embodiment, in block **1706**, the HH electronic device **140** (first electronic device) is placed in front of the user's face, and the TV **120** (second electronic device) recognizes the user face (e.g., performs facial recognition). In one embodiment, in block **1707** the TV **120** associates the user face (first user face) with the HH electronic device **140**. In one embodiment, the server pairs the HH electronic device with the TV **120** based on matching the received images and the commands including time-stamps from the TV **120** and the HH electronic device **140**, and the location information if available.

In one embodiment, in block **1708** the TV **120** determines the distance from the HH electronic device **140** to the TV **120** based on the size of the displayed image on the HH electronic device **140**, the size of the image captured by the TV camera **122** of the TV **120**, and the focal length of the TV camera **122**. In one example embodiment, in block **1709** the TV **120** may determine the relative position of the HH electronic device **140** with respect to the user face. In one embodiment, in block **1710** the TV **120** adjusts the display based on one or more of the determined distance to the HH electronic device **140** and the determined relative position of the user face. In one embodiment, the TV **120** adjusts the display to the user of the HH electronic device by targeting text/graphics/video in a particular position on the screen, increases font size, etc.

In one embodiment, the process **1700** stops at block **1711**, where the application may proceed to a next step for communication between the HH electronic device **140** and the TV **120**, or communicate using another application, etc.

One embodiment provides for precisely locating the position of a user HH electronic device **140** in an enclosed space (mall, airport, college) etc. where GPS signals or Wi-Fi might not be accurate (e.g., location information is not available). In one embodiment, the precise location of the user may be determined relative to the location of the TV **120** (or TV camera **122**). In one embodiment, the TV **120** is static and its position is known (e.g., by a server) and it does not change. In one embodiment, similarly as to process **1700**, the user holds up an HH electronic device **140** and starts the convergence App. In one example embodiment, the App shows a fixed size image with a characteristic (e.g., color, shape, pattern, etc.) which is associated with the HH electronic device **140**.

In one example embodiment, the TV-HH pairing occurs as in process **1700**. In one embodiment, since the HH electronic device **140** shows a fixed size image with a characteristic, the TV **120** may determine the distance based on the size of the image as seen by TV camera **122**. In one embodiment, the distance of the HH electronic device **140** from TV **120** is equal to the diameter of the image (e.g., a circle, blob, etc.) divided by the diameter of the image received by the TV camera **122** multiplied by the focal length of the TV camera **122** lens.

In one example embodiment, the server may request the HH electronic devices to change the characteristic of the displayed image, and the TV **120** recognizes a characteristic change to the image displayed by the HH electronic device **140**. In one example embodiment, the TV **120** sends the

server information about the image and changed characteristic as captured from the HH electronic device **140** using the TV camera **122**.

In one or more embodiments, in the CAN/MAN environment, various uses may be applied. In one example, in a sports bar, persons in front of the TV **120** may be identified and based on their identity (and associated profile information, personal information known, etc.), the TV **120** shows the user particular scores of preferred teams or interested games/events/etc. only on a particular TV **120** based on the user of the HH electronic device **140** being in front of or near to the particular TV **120**.

In one example embodiment, users of HH electronic devices **140** may sit in front of a TV **120** and request the TV **120** to show only information that they are interested in from commands from their HH electronic devices **140**. In one embodiment, the TV **120** may arbitrate this information if there are multiple HH electronic devices **140** (e.g., majority requests, switching between requests using weighted time periods, etc.).

In one example embodiment, in an airport, the precise location of the person using an HH electronic device **140** may be identified by the TV **120** that they are standing in front of. In one example embodiment, the TV **120** may provide the particular users directions, arrival/destination information pertinent to them, or provide live assistance.

In one example embodiment, in a mall, the TV **120** may show information and photos/video (e.g., with products, services, etc.) on a TV **120** near the user and make it a social experience. In one embodiment, the TV **120** may provide for users of HH electronic device **140** to play games, be offered coupons that tie a consumer to a location, etc.

In one embodiment, multiple TVs **120** that are positioned in series or in the path direction of a user of an HH electronic device **140** may transition based on the position of the HH electronic device **140**. In one embodiment, the user may be targeted with content on a specific TV **120** based on the time the HH electronic device **140** remains in front of a specific place (e.g., store, display, etc.). In one embodiment, based on information obtained for multiple users of HH electronic devices **140** that may be traveling together, the TV **120** may determine common information that the multiple users may be interested in to target both users simultaneously.

FIG. **18** shows another example **1800** determination of location of a user relative to a perpendicular from a paired device, according to an embodiment. In one embodiment, example **1800** shows the user position (angle) relative to the perpendicular **1840** from the face of the TV. In one embodiment, a user who is located at a distance “d” **1830** from the center of the image. The angle “a” **1820** that the user makes with the perpendicular from the face of the TV **120** is given by the simple formulae

$$a = \arctan(d/f)$$

where “f” **1810** is the focal length of the TV camera **122**.

FIG. **19** is a high-level block diagram showing an information processing system comprising a computing system **500** implementing an embodiment. The system **500** includes one or more processors **511** (e.g., ASIC, CPU, etc.), and can further include an electronic display device **512** (for displaying graphics, text, and other data), a main memory **513** (e.g., random access memory (RAM)), storage device **514** (e.g., hard disk drive), removable storage device **515** (e.g., removable storage drive, removable memory module, a magnetic tape drive, optical disk drive, computer-readable medium having stored therein computer software and/or data), user interface device **516** (e.g., keyboard, touch screen, keypad,

pointing device), and a communication interface **517** (e.g., modem, wireless transceiver (such as WiFi, Cellular), a network interface (such as an Ethernet card), a communications port, or a PCMCIA slot and card). The communication interface **517** allows software and data to be transferred between the computer system and external devices through the Internet **550**, mobile electronic device **551**, a server **552**, a network **553**, etc. The system **500** further includes a communications infrastructure **518** (e.g., a communications bus, cross-over port, or network) to which the aforementioned devices/modules **511** through **517** are connected.

The information transferred via communications interface **517** may be in the form of signals such as electronic, electromagnetic, optical, or other signals capable of being received by communications interface **517**, via a communication link that carries signals and may be implemented using wire or cable, fiber optics, a phone line, a cellular phone link, an radio frequency (RF) link, and/or other communication channels.

In one implementation of one or more embodiments in a mobile wireless device such as a mobile phone, the system **500** further includes an image capture device **520**, such as a camera **145** (FIG. **2**), and an audio capture device **519**, such as a microphone. The system **500** may further include application modules as MMS module **521**, SMS module **522**, email module **523**, social network interface (SNI) module **524**, audio/video (AV) player **525**, web browser **526**, image capture module **527**, etc.

The system **500** further includes a network access (and pairing) and application connection module **530** as described herein, according to an embodiment. In one implementation of network access and application connection processes **530** along with an operating system **529** may be implemented as executable code residing in a memory of the system **500**. In another embodiment, such modules are in firmware, etc.

As is known to those skilled in the art, the aforementioned example architectures described above, according to said architectures, can be implemented in many ways, such as program instructions for execution by a processor, as software modules, microcode, as computer program product on computer readable media, as analog/logic circuits, as application specific integrated circuits, as firmware, as consumer electronic devices, AV devices, wireless/wired transmitters, wireless/wired receivers, networks, multi-media devices, etc. Further, embodiments of said Architecture can take the form of an entirely hardware embodiment, an entirely software embodiment or an embodiment containing both hardware and software elements.

Embodiments have been described with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems) and computer program products according to one or more embodiments. Each block of such illustrations/diagrams, or combinations thereof, can be implemented by computer program instructions. The computer program instructions when provided to a processor produce a machine, such that the instructions, which execute via the processor, create means for implementing the functions/operations specified in the flowchart and/or block diagram. Each block in the flowchart/block diagrams may represent a hardware and/or software module or logic, implementing one or more embodiments. In alternative implementations, the functions noted in the blocks may occur out of the order noted in the figures, concurrently, etc.

The terms “computer program medium,” “computer usable medium,” “computer readable medium”, and “computer program product,” are used to generally refer to media such as main memory, secondary memory, removable storage drive, a hard disk installed in hard disk drive. These computer pro-

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gram products are means for providing software to the computer system. The computer readable medium allows the computer system to read data, instructions, messages or message packets, and other computer readable information from the computer readable medium. The computer readable medium, for example, may include non-volatile memory, such as a floppy disk, ROM, flash memory, disk drive memory, a CD-ROM, and other permanent storage. It is useful, for example, for transporting information, such as data and computer instructions, between computer systems. Computer program instructions may be stored in a computer readable medium that can direct a computer, other programmable data processing apparatus, or other devices to function in a particular manner, such that the instructions stored in the computer readable medium produce an article of manufacture including instructions which implement the function/act specified in the flowchart and/or block diagram block or blocks.

Computer program instructions representing the block diagram and/or flowcharts herein may be loaded onto a computer, programmable data processing apparatus, or processing devices to cause a series of operations performed thereon to produce a computer implemented process. Computer programs (i.e., computer control logic) are stored in main memory and/or secondary memory. Computer programs may also be received via a communications interface. Such computer programs, when executed, enable the computer system to perform the features of one or more embodiments as discussed herein. In particular, the computer programs, when executed, enable the processor and/or multi-core processor to perform the features of the computer system. Such computer programs represent controllers of the computer system. A computer program product comprises a tangible storage medium readable by a computer system and storing instructions for execution by the computer system for performing a method of one or more embodiments.

Though the embodiments have been described with reference to certain versions thereof; however, other versions are possible. Therefore, the spirit and scope of the appended claims should not be limited to the description of the preferred versions contained herein.

What is claimed is:

1. A method for device pairing, comprising:
 - determining, by one or more processors using optical recognition, whether an image is recognizable based on the image having a first characteristic, the image corresponding to a first application executing on and displayed by a first electronic device, wherein a characteristic comprises a graphic object having at least one of a shape, a color and a pattern;
 - in response to a determination that the image is recognizable based on the first characteristic by a second electronic device, pairing the first electronic device with the second electronic device;
 - in response to a determination that the image is not recognizable by the second electronic device, changing the first characteristic to at least one second characteristic, recognizing the at least one second characteristic that is different from the first characteristic by the second electronic device, and pairing the first electronic device with the second electronic device based on the second characteristic.
2. The method of claim 1, further comprising:
 - in response to a determination that the image is not recognizable or distinguishable from images with a first characteristic that are present within a particular area:

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transmitting, to the first electronic device, a request to change the first characteristic to the at least one second characteristic;

wherein the at least one second characteristic is different for the first electronic device and any other electronic devices that are present within the particular area.

3. The method of claim 2, wherein the first characteristic comprises a graphic object having a first shape and a first color, and the second characteristic comprise a graphic object having at least one of a second shape and a second color.

4. The method of claim 3, wherein the first characteristic or the at least one second characteristic are assigned for future device connections, and the second characteristic is randomly selected, and each of the first characteristic and the second characteristic further comprises one of a static pattern and a dynamic pattern.

5. The method of claim 4, further comprising:

- identifying, the first electronic device based on different second characteristics; and

transmitting a request to the first electronic device to change to a specific second characteristic that is unique.

6. The method of claim 5, further comprising:

- performing facial recognition to recognize different users of the first electronic device and one or more other electronic devices; and
- assigning distinct identifications based on the facial recognition.

7. The method of claim 5, further comprising:

- recognizing a face in front of the first electronic device; and
- associating the face with the first electronic device.

8. The method of claim 5, further comprising:

- recognizing a face, next to the first electronic device; and
- associating a face or the first electronic device based on determining whether the first electronic device is a personal electronic device or a communal electronic device.

9. The method of claim 5, further comprising:

- recognizing a first face and a second face;
- associating the first user face with the first electronic device and the second user face with the third electronic device;
- determining relative positions of the first electronic device with respect to a third electronic device; and
- following movement of each of the first electronic device and the third electronic device.

10. The method of claim 9, wherein the first device is a mobile electronic device, and the second electronic device comprises a television device connected with an imaging device.

11. The method of claim 9, wherein the first electronic device, the one or more other electronic devices and the second electronic device are each connected to a network.

12. An electronic apparatus comprising:

- an imaging device to capture an image; and
- one or more processors configured to use optical recognition to determine whether the image is recognizable based on the image having a first characteristic by an electronic device, the image corresponding to a first application executing on and displayed by a mobile electronic device, wherein a characteristic comprises a graphic object having at least one of a shape, a color and a pattern, the one or more processors configured to cause an electronic device to pair with the mobile electronic device in response to a determination that the image is recognizable based on the first characteristic by the electronic device, the one or more processors further configured to change the first characteristic to at least one second characteristic in response to a determination that the image is not recognizable by the electronic device, to

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recognize the at least one second characteristic that is different from the first characteristic, and to pair the electronic device with the mobile electronic device based on the second characteristic.

13. The electronic apparatus of claim 12, wherein in response to the determination that the image is unrecognizable or a determination that the image is not distinguishable from images with the first characteristic for any other electronic devices that are present within a particular area:

the electronic device is configured to send a request to change the first characteristic to the mobile electronic device to the at least one second characteristic, and the electronic device is configured to pair with the mobile device based on the one or more processors configured to use optical recognition for the at least one second characteristic.

14. The electronic apparatus of claim 13, wherein the electronic device is configured to transmit the request to change the first characteristic to the second characteristic for any other electronic devices that are present in a particular area, and the second characteristic is different for each of the other electronic devices and from the second characteristic of the mobile electronic device.

15. The electronic apparatus of claim 14, wherein the first characteristic comprises a graphic object having a first shape and a first color and the second characteristic comprises a graphic object having at least one of a second shape and a second color.

16. The electronic apparatus of claim 15, wherein the second characteristic of the mobile electronic device is assigned for future device connections to the electronic device, the mobile electronic device is identified based on the at least one second characteristic, the electronic device is configured to transmit a request to the mobile device and to the other electronic devices that are present within the particular area to change to a specific second characteristic that is unique, and each of the first characteristic and the second characteristic further comprises one of a static pattern and a dynamic pattern.

17. The electronic apparatus of claim 16, wherein the one or more processors are configured to perform facial recognition using the imaging device for recognizing facial features, and to assign distinct identifications based on the facial recognition.

18. The electronic apparatus of claim 16, wherein the one or more processors are configured to perform facial recognition using the imaging device and to associate the mobile electronic device based on the facial recognition.

19. The electronic apparatus of claim 16, wherein the one or more processors are configured to recognize a face in front of the mobile electronic device using the imaging device, to determine a distance from the mobile electronic device to the electronic device based on a size of the at least one image and a focal length of the imaging device, to determine whether the mobile electronic device comprises a personal electronic device or a communal electronic device, and to associate the face or the mobile electronic device based on the determination.

20. The electronic apparatus of claim 16, wherein the one or more processors are configured to recognize a first face in front of the mobile electronic device and a second face in front of another mobile electronic device, to associate the first face with the mobile electronic device and the second face with the another mobile electronic device, to determine relative positions of the mobile electronic device with respect to the

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another mobile electronic device, and to follow movement of each of the mobile electronic device and the another mobile electronic device.

21. The electronic apparatus of claim 12, wherein the electronic device is a television device.

22. A non-transitory computer-readable medium having instructions which when executed on a computer perform a method comprising:

determining, by one or more processors using optical recognition, whether an image is recognizable based on the image having a first characteristic, the image corresponding to a first application executing on and displayed by a first electronic device wherein a characteristic comprises a graphic object having at least one of a shape, a color and a pattern;

in response to a determination that the image is recognizable by a second electronic device, pairing the first electronic device with the second electronic device based on the first characteristic;

in response to a determination that the image is not recognizable by the second electronic device, changing the first characteristic to at least one second characteristic, recognizing the at least one second characteristic that is different from the first characteristic by the second electronic device, and pairing the first electronic device with the second electronic device based on the second characteristic.

23. The non-transitory computer-readable medium of claim 22, wherein the program when executed by the computer performs the method further comprising:

in response to a determination that the image is not recognizable or distinguishable from images with the first characteristic for any other electronic devices that are present within a particular area:

transmitting, by the second electronic device, a request to change the first characteristic to the at least one second characteristic by the first electronic device and any other electronic devices that are present within the particular area;

wherein the at least one second characteristic is different for the first electronic device and each of the other electronic devices that are present within the particular area, and the first characteristic comprises a graphic object having a first shape and a first color, and the second characteristic comprises a graphic object having at least one of a second shape and a second color.

24. The non-transitory computer-readable medium of claim 23, wherein the first characteristic or the at least one second characteristic of the first electronic device and the other electronic devices that are present within the particular area are assigned for future connections to the second electronic device, and each of the first characteristic and the second characteristic further comprises one of a static pattern and a dynamic pattern.

25. The non-transitory computer-readable medium of claim 24, wherein the program when executed by the computer performs the method further comprising:

identifying, by the second electronic device, each electronic device based on the different at least one second characteristics; and

requesting, by the second electronic device, the first electronic device and the other electronic devices that are present in the particular area to change to a specific second characteristic that is different for each electronic device.

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26. The non-transitory computer-readable medium of claim **25**, wherein the program when executed by the computer performs the method further comprising:

recognizing, by the second electronic device, a face in front of the first electronic device; and
 associating, by the second electronic device, the face with the first electronic device.

27. The non-transitory computer-readable medium of claim **25**, wherein the program when executed by the computer performs the method further comprising:

recognizing, by the second electronic device, the face in front of the first electronic device;

determining, by the second electronic device, a distance from the first electronic device to the second electronic device based on a size of the image and a focal length of an imaging device of the second electronic device;

in response to a determination that the first electronic device comprises a personal electronic device, associating the first electronic device with the second electronic device; and

in response to a determination that the first electronic device comprises a communal electronic device, associating, by the second electronic device, the face with the first electronic device.

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28. The non-transitory computer-readable medium of claim **25**, wherein the program when executed by the computer performs the method further comprising:

recognizing, by the second electronic device, a first face and a second face;

associating, by the second electronic device, the first face with the first electronic device and the second face with a third electronic device;

determining, by the second electronic device, relative positions of the first electronic device with respect to the third electronic device; and

following, by the second electronic device, movement of each of the first electronic device and the third electronic device.

29. The non-transitory computer-readable medium of claim **22**, wherein the first electronic device is a mobile electronic device, and the second electronic device comprises a television device connected with an imaging device.

30. The non-transitory computer-readable medium of claim **22**, wherein the first electronic device, the other electronic devices that are present within the particular area and the second electronic device are each connected to a network.

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